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MEDICO-CHIRURGICAL TRANSACTIONS.

PUBLISHED BY

THE ROYAL

MEDICAL AND CHIRURGICAL SOCIETY

OF

LONDON.

VOLUME THE FORTY-FIFTH.

LONDON:
LONGMAN, GREEN, LONGMAN, AND ROBERTS,
PATERNOSTER ROW.

1862.

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SECOND SERIES.

VOLUME THE TWENTY-SEVENTH.

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The figures succeeding the words *Trans.* and *Pro.* show the number of Papers which have been contributed to the Transactions or Proceedings by the Fellow to whose name they are annexed.

OCTOBER 1862.

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Amongst the non-residents, those marked thus (*) are entitled by composition to receive the Transactions.

Elected

1841 *James Abercrombie, M.D., Cape of Good Hope.

1846 *John Abercrombie, M.D., Physician to the Cheltenham General Hospital, 13, Suffolk square, Cheltenham.

1851 *Henry Wentworth Acland, M.D., F.R.S., Physician to the Radcliffe Infirmary; Regius Professor of Medicine, and Clinical Professor in the University of Oxford.

1847 Elias Acosta, M.D., New York, U.S.

1842 William Acton, 17, Queen Anne street, Cavendish square. *Trans.* 1.

Elected

1851 John Adams, Surgeon to, and Lecturer on Descriptive and Surgical Anatomy at, the London Hospital; 4, St. Helen's place, Bishopsgate street. *Trans.* 3.

1852 William Adams, Surgeon to the Royal Orthopædic Hospital; Lecturer on Anatomy and Surgery at the Grosvenor place School of Anatomy and Medicine; 5, Henrietta street, Cavendish square. *Trans.* 2.

1837 *Ralph Fawsett Ainsworth, M.D., Physician to the Manchester Royal Infirmary; Cliff Point, Lower Broughton, Manchester.

1839 Sir Rutherford Alcock, K.C.B., K.C.T., K.T.S., H.M.'s Envoy Extraordinary and Consul-General in Japan. *Trans.* 1.

1826 James Alderson, M.D., F.R.S., Senior Physician to, and Lecturer on Clinical Medicine at, St. Mary's Hospital; 17, Berkeley square. S. 1829. C. 1848. T. 1849. V.P. 1852-3. *Trans.* 3.

1843 Charles James Berridge Aldis, M.D., Medical Officer of Health for St. George's, Hanover square; Senior Physician to the Surrey Dispensary; and Physician to the St. Paul and St. Barnabas Dispensary; 1, Chester terrace, Chester square. *Trans.* 2.

1850 Charles Revans Alexander, Surgeon to the Royal Infirmary for Diseases of the Eye; 6, Cork street, Bond street.

1836 Henry Ancell, 3, Norfolk crescent, Oxford square. C. 1847-8. *Trans.* 2.

1862 Edwyn Andrew, M.D., Windsor House, Shrewsbury.

1862 James Andrew, M.B., Warden of the College, St. Bartholomew's Hospital.

1820 Thomas Andrews, M.D., Norfolk, Virginia.

1819 Professor Antommarchi, Florence.

1819 †James Moncrieff Arnott, F.R.S., 2, New Burlington street. L. 1826-8. V.P. 1832-3. T. 1835-40. C. 1846, 1855-6. P. 1847-8. *Trans.* 8.

1817 †John Ashburner, M.D., F.L.S., 7, Hyde park place, Cumberland gate. C. 1821, 1830-1.

1851 Thomas John Ashton, 31, Cavendish square.

Elected

1825 †Benjamin Guy Babington, M.D., F.R.S., *President*, Physician to the Asylum for Deaf and Dumb; Consulting Physician to the German Hospital, and to the City of London Hospital for Diseases of the Chest; 31, George street, Hanover square. C. 1829. V.P. 1845-6. T. 1848. P. 1861-2. *Trans.* 2.

1838 Francis Badgley, M.D., Holyrood House, Great Malvern.

1820 *John Badley, Dudley, Worcestershire.

1840 William Bainbridge, late of Kingston, Surrey.

1836 Andrew Wood Baird, M.D., Physician to the Dover Hospital; Dover, Kent.

1851 *Alfred Baker, Surgeon to the Birmingham General Hospital, and Lecturer on Surgery at Sydenham College; Cannon street, Birmingham.

1839 †Thomas Graham Balfour, M.D., F.R.S., Deputy Inspector-General of Hospitals; 10, Sumner place, Onslow square, Brompton. C. 1852-3. V.P. 1860-1. *Trans.* 2.

1848 Edward Ballard, M.D., Medical Officer of Health for Islington; 7, Compton terrace, Upper street, Islington. *Trans.* 2.

1849 Thomas Ballard, 10, Southwick place, Hyde park.

1847 Andrew Whyte Barclay, M.D., *Librarian*, Physician to, and Lecturer on Materia Medica at, St. George's Hospital; Medical Officer of Health for Chelsea; 23a, Bruton street, Berkeley square. S. 1857-60. L. 1861-2. *Trans.* 2.

1848 Edgar Barker, 9, Oxford square, Hyde park.

1862 Edgar Barker, jun., Surgeon to the Western General Dispensary; 5, Albion place, Hyde park square.

1833 †Thomas Alfred Barker, M.D., *Treasurer*, Senior Physician to, and Lecturer on Clinical Medicine at, St. Thomas's Hospital; 71, Grosvenor street. C. 1844-5. V.P. 1853-4. T. 1860-2. *Trans.* 6.

1843 Thomas Herbert Barker, M.D., F.R.S.E., Harpur place, Bedford.

1847 George Hilaro Barlow, M.D., Physician to, and Lecturer on Clinical Medicine at, Guy's Hospital; Physician to the Magdalen Hospital; 5, Union street, Southwark. C. 1859.

Elected

1861 Robert Barnes, M.D., Physician to the Royal Maternity Charity, and Assistant Obstetric Physician to the London Hospital; Lecturer on Midwifery at St. Thomas's Hospital; 12, Finsbury square. *Trans.* 3.

1840 Benjamin Barrow, Surgeon to the Royal Isle of Wight Infirmary; Clifton House, Ryde, Isle of Wight.

1859 Richard Barwell, Assistant-Surgeon to, and Lecturer on Comparative Anatomy at, the Charing Cross Hospital; 22, Old Burlington street. *Trans.* 1.

1844 William Richard Basham, M.D., Senior Physician to, and Lecturer on Medicine at, the Westminster Hospital; 17, Chester street, Grosvenor place. S. 1852-4. C. 1860-1. *Trans.* 2.

1862 Lionel Smith Beale, M.B., F.R.S., Professor of Physiology and General and Morbid Anatomy in King's College, London, and Physician to King's College Hospital; 61, Grosvenor street.

1860 Adam Bealey, M.D., M.A. Camb., Physician to the Royal General Dispensary, St. Pancras; 27, Tavistock square.

1841 George Beaman, M.D., 5, Lancaster place, Strand.

1856 Amos Beardsley, Bay Villa Grange, Newton in Cartmel, Lancashire.

1836 William Beaumont, Professor of Surgery in the University of King's College, Toronto, Upper Canada. *Trans.* 2.

1840 Charles Beevor, 41, Upper Harley street.

1858 William Chapman Begley, M.D., Middlesex County Lunatic Asylum, Hanwell.

1819 †Thomas Bell, F.R.S., F.L.S., Selborne, Hants. C. 1832-3. V.P. 1854. *Trans.* 1.

1847 James Henry Bennet, M.D., Physician-Accoucheur to the Royal Free Hospital; The Ferns, Weybridge.

1845 Edward Unwin Berry, 7, James street, Covent garden.

1820 Stephen Bertin, Paris.

1815 †Archibald Billing, M.D., F.R.S., Member of the Senate of the University of London; 6, Grosvenor Gate. C. 1825. V.P. 1828-9.

Elected

1827 William Birch, Barton-under-Needwood, Staffordshire. *Trans.* 2.

1850 James Bird, M.D., Lecturer on Military Surgery at St. Mary's Hospital Medical School; 27, Hyde park square.

1855 Peter Hinckes Bird, F.L.S., 1, Norfolk square, Hyde park.

1856 William Bird, Surgeon to the West of London Hospital, and the St. George's and St. James's Dispensary; 24, George street, Hanover square.

1849 Edmund Lloyd Birkett, M.D., Physician to the City of London Hospital for Diseases of the Chest; 48, Russell square.

1851 George Birkett, M.D., Lecturer on Medical Jurisprudence at the Charing Cross Hospital; Northumberland House, Green lanes, Stoke Newington.

1851 John Birkett, F.L.S., Surgeon to, and Lecturer on Surgery at, Guy's Hospital; 59, Green street, Grosvenor square. L. 1856-7. *Trans.* 4.

1846 Hugh Birt, British Naval Hospital, Valparaiso.

1843 Patrick Black, M.D., Physician to, and Lecturer on Medicine at, St. Bartholomew's Hospital; 11, Queen Anne street, Cavendish square. C. 1856.

1847 George C. Blackman, M.D., Professor of Surgery in the Medical College of Ohio; New York, U.S.

1840 Peyton Blakiston, M.D., F.R.S., St. Leonard's-on-Sea.

1845 Henry Blenkinsop, Senior Surgeon to the Warwick Dispensary; Jury street, Warwick.

1823 Louis Henry Bojanus, M.D., Wilna.

1846 Peter Bossey, 4, Broadwater road, Worthing, Sussex.

1846 John Ashton Bostock, Hon. Surgeon to H.M. the Queen; Surgeon-Major, Scots Fusilier Guards; 54, Chester square, Belgravia. C. 1861-2.

1841 William Bowman, F.R.S., *Vice-President*, Surgeon to the Royal London Ophthalmic Hospital, Moorfields; 5, Clifford street, Bond street. C. 1852-3. V.P. 1862. *Trans.* 3.

Elected

1862 William Henry Brace, Surgeon to the Bath United Hospital; 1, Gay street, Bath.

1857 William Brinton, M.D., Physician to, and Lecturer on Physiology at, St. Thomas's Hospital; 24, Brook street, Grosvenor square.

1851 Bernard Edward Brodhurst, Assistant-Surgeon to the Royal Orthopædic Hospital, and Senior Surgeon to the Hon. Artillery Company; 20, Grosvenor street. *Trans.* 2; *Pro.* 1.

1813 †Sir Benjamin Collins Brodie, Bart., D.C.L., F.R.S., Serjeant-Surgeon to H.M. the Queen, Foreign Correspondent of the Institute of France, and Foreign Associate of the Imperial Academy of Medicine of Paris; Broome park, Betchworth, Surrey. C. 1814-15, 1818-19, 1821-2, 1835-6, 1841-2, 1849. V.P. 1816-17. P. 1839-40. *Trans.* 12.

1844 Charles Brooke, M.A., F.R.S., Surgeon to, and Lecturer on Surgery at, the Westminster Hospital; 16, Fitzroy square. C. 1855.

1848 William Philpot Brookes, M.D.

1854 *Henry Brown, Surgeon to H.M. the Queen, and the Royal Household; Windsor.

1857 *Robert Brown, Surgeon to the Carlisle Dispensary; 4, Devonshire street, Carlisle.

1860 Charles Edouard Brown-Séquard, M.D., F.R.S., Physician to the National Hospital for the Paralysed and Epileptic; 25, Cavendish square.

1851 Alexander Browne, M.D., Twynholm, Kirkcudbright.

1860 Thomas Bryant, Assistant-Surgeon to, and Demonstrator of Operative Surgery at, Guy's Hospital; 2, Finsbury square. *Trans.* 3; *Pro.* 1.

1855 Walter John Bryant. L.R.C.P. Edinb., 7, Bathurst street, Hyde park gardens.

1823 B. Bartlet Buchanan, M.D.

1843 John Charles Bucknill, M.D., one of the Visiting Physicians to the Court of Chancery, Medical Superintendent of the Devon County Lunatic Asylum, Exminster, Devonshire.

Elected

1839 George Budd, M.D., F.R.S., Consulting Physician to the Seamen's Hospital Ship 'Dreadnought;' 20, Dover street, Piccadilly. C. 1846-7. V.P. 1857. *Trans.* 5.

1839 Thomas Henry Burgess, M.D., Portsmouth.

1853 Patrick Burke, 13, Upper Montagu street, Montagu square.

1854 Philip Burrowes, Surgeon to the London City Mission, and Assistant-Surgeon to the Hospital for Women; 88, Gloucester crescent, Hyde park.

1833 †George Burrows, M.D., F.R.S., Physician to St. Bartholomew's Hospital; 18, Cavendish square. C. 1839-40, 1858-9. T. 1845-7. V.P. 1849-50. *Trans.* 2.

1820 Samuel Burrows.

1837 George Busk, F.R.S., F.L.S., Examiner in Comparative Anatomy at the University of London; Surgeon to the Seamen's Hospital Ship 'Dreadnought;' 15, Harley street, Cavendish square. C. 1847-8. V.P. 1855. *Trans.* 4.

1818 John Butter, M.D., F.R.S., F.L.S., Physician Extraordinary to the Plymouth Royal Eye Infirmary; Plymouth.

1851 *William Cadge, Surgeon to the Norfolk and Norwich Hospital; All Saints, Norwich. *Trans.* 1.

1851 Thomas Callaway, Algiers.

1861 George William Callender, Assistant-Surgeon to, and Lecturer on Anatomy at, St. Bartholomew's Hospital; 47, Queen Anne street, Cavendish square.

1852 *George Canney, Bishop-Auckland, Darlington, Durham.

1847 John Burford Carlill, M.D., Surgeon-Accoucheur to the Newman street Lying-in Institution; 57, Berners street.

1825 Harry W. Carter, M.D., F.R.S.E., Consulting Physician to the Kent and Canterbury Hospital; Kennington Hall, Ashford, Kent.

1853 Robert Brudenell Carter, Surgeon to the Nottingham Eye Dispensary; Nottingham.

1820 †Samuel Cartwright, F.R.S., F.L.S., Nizell's house, near Tunbridge, Kent.

1845 Samuel Cartwright, jun., Professor of Dental Surgery at King's College, London; Surgeon-Dentist to King's College Hospital; 32, Old Burlington street. C. 1860-1.

Elected

1839 William Cathrow, 42, Weymouth street, Portland place. C. 1860-1.

1845 William Oliver Chalk, Surgeon to the St. Marylebone Eye and Ear Institution; 3, Nottingham terrace, York gate, Regent's park.

1844 Thomas King Chambers, M.D., Physician to, and Lecturer on Medicine at, St. Mary's Hospital; Physician to the Lock Hospital; 22B, Brook street, Grosvenor square. *Trans.* 1. C. 1861.

1859 Frank Chance, M.B., 51, Wimpole street, Cavendish square.

1849 Frederick Chapman, Richmond green, Surrey.

1837 Henry Thomas Chapman, 16, Lower Seymour street, Portman square. C. 1858.

1852 George Borlase Childs, Surgeon-in-Chief to the City Police Force, and Surgeon to the Metropolitan Free Hospital; 11, Finsbury place South.

1842 William Dingle Chowne, M.D., Physician to, and Lecturer on Medicine and Midwifery at, the Charing Cross Hospital; Corresponding Fellow of the Royal Academy of Surgery of Madrid; 8, Connaught place West, Hyde park. C. 1853-4.

1860 Andrew Clark, M.D., Assistant-Physician to, and Lecturer on Physiology at, the London Hospital; 23, Montague place, Russell square.

1839 Frederick le Gros Clark, Surgeon to, and Lecturer on Surgery at, St. Thomas's Hospital; Surgeon to the Magdalen Hospital; Consulting Surgeon to the Western General Dispensary, and to the London Female Penitentiary, Pentonville; 14, St. Thomas's street, Southwark, and Lee, Kent. S. 1847-9. V.P. 1855-6. *Trans.* 3.

1862 Charles Hall Clarke, M.D., Stonyhurst College, near Blackburn, Lancashire.

1818 John Clarke, M.D., Physician to the British Lying-in Hospital, and Assistant-Physician to the General Lying-in Hospital; 42, Hertford street, May fair.

Elected

1861 *William James Clarke, Surgeon to the Huddersfield Infirmary; John William street, Huddersfield, Yorkshire.

1850 Josiah Clarkson, New Hall street, Birmingham. *Trans.* 1.

1842 Oscar Moore Passey Clayton, 87, Harley street.

1853 Joseph Thomas Clover, 3, Cavendish place, Cavendish square.

1857 Charles Coates, F.R.C.P., Edinb., Physician to the Bath United General Hospital; 10, Circus, Bath.

1851 Edward Cock, Senior Surgeon to, and Lecturer on Clinical Surgery at, Guy's Hospital; Consulting Surgeon to the Asylum for Deaf and Dumb; 11, St. Thomas's street east; Southwark: C. 1857. *Trans.* 3.

1850 Daniel Whitaker Cohen, M.D.

1835 *William Colborne, Chippenham, Wiltshire.

1818 Robert Cole, F.L.S., Holybourne, Hampshire.

1855 Frederick Collins, M.D., Medical Officer of Health for Wanstead; Wanstead, Essex.

1828 John Conolly, M.D., D.C.L., Consulting Physician to the Middlesex County Lunatic Asylum, Hanwell.

1840 *William Robert Cooke, Burford, Oxfordshire.

1819 George Cooper, Brentford, Middlesex.

1841 George Lewis Cooper, one of the Surgeons to the National Vaccine Institution, and Teacher of Vaccination to the Medical School of University College; Surgeon to the Bloomsbury Dispensary; 7, Woburn place, Russell square. C. 1860-1.

1843 William White Cooper, Surgeon-Oculist in Ordinary to H.M. the Queen; and Ophthalmic Surgeon to, and Lecturer on Ophthalmic Surgery at, St. Mary's Hospital; 19, Berkeley square. C. 1858-9.

1841 Holmes Coote, Senior-Assistant-Surgeon to, and Lecturer on Surgery at, St. Bartholomew's Hospital, and Assistant-Surgeon to the Royal Orthopædic Hospital; 13, Queen Anne street, Cavendish square. S. 1853-4. *Trans.* 1.

1835 George Ford Copeland, Cheltenham.

Elected

1822 †James Copland, M.D., F.R.S., Consulting Physician to the Royal Infirmary for Children, and to the Great Northern Hospital, King's Cross; Hon. Fellow of the Royal Academy of Sciences of Sweden, &c.; 5, Old Burlington street. C. 1831. V.P. 1838-9. P. 1853-4.

1847 John Rose Cormack, M.D., F.R.S.E., 5, Bedford square

1860 *Thomas Charles Steuart Corry, M.D., Surgeon to the Belfast General Dispensary; 1, Victoria street, Belfast.

1839 *Charles Cæsar Corsellis, M.D., F.L.S., Benson, Oxon.

1853 William Gillett Cory, M.D., Middleton Lodge, Brighton.

1847 Richard Payne Cotton, M.D., Physician to the Hospital for Consumption and Diseases of the Chest; 46, Clarges street, Piccadilly.

1828 †William Coulson, Senior Surgeon to St. Mary's Hospital; Consulting Surgeon to the German Hospital; 1, Chester terrace, Regent's park. C. 1831. L. 1832-7 V.P. 1851-2. *Trans.* 1.

1860 †John Couper, Assistant-Surgeon to the London Hospital; 33, Finsbury Circus.

1862 George Cowell, 4, St. George's square, Pimlico.

1841 Mervyn Archdall Nott Crawford, M.D., Wiesbaden. C. 1853-4.

1847 George Critchett, Surgeon to the London Hospital, and Surgeon to the Royal London Ophthalmic Hospital, Moorfields; 46, Finsbury square. *Trans.* 1.

1862 Samuel Crompton, Betteshanger Parsonage, Sandwich, Kent.

1837 John Farrar Crookes, Harewell, near Faversham, Kent.

1860 Richard Cross, M.D., Physician to the Royal Northern Sea-Bathing Infirmary; Queen street, Scarborough.

1849 *William Edward Crowfoot, Beccles, Suffolk.

1851 James Cameron Cumming, M.D., 1, Cadogan place, Sloane street.

1846 Henry Curling, Surgeon to the Margate Royal Sea-Bathing Infirmary, and the Ramsgate Seamen's Infirmary; Ramsgate, Kent.

Elected

1837 Thomas Blizard Curling, F.R.S., Surgeon to, and Lecturer on Surgery at, the London Hospital; Examiner in Surgery at the University of London; 39, Grosvenor street. S. 1815-6. C. 1850. T. 1854-7. V.P. 1859. *Trans.* 13; *Pro.* 1.

1847 John Edmund Currey, M.D., Lismore, County Waterford.

1836 George Cursham, M.D., Physician to the Female Orphan Asylum; and Inspector of Anatomy for the Provinces; 55, Victoria street, Westminster. S. 1842-7. C. 1850-1. V.P. 1855. T. 1856-8. *Trans.* 1.

1822 Christopher John Cusack, Chateau d'Eu, France.

1852 Thomas Cutler, M.D., Acting Physician at the Spa Waters; Spa, Belgium.

1836 *James Stock Daniel, Ramsgate, Kent.

1848 Henry Daubeny.

1846 Frederick Davies, M.D., Surgeon to the Northern Dispensary; 19, Upper Gower street, Bedford square.

1847 John Davies, M.D., Physician Extraordinary to the Hertford General Infirmary, and Visiting Physician to the Hadham Palace Lunatic Asylum, Hertford.

1853 Robert Coker Nash Davies, Rye, Sussex.

1852 William Davies, M.D., 10, Gay street, Bath.

1852 John Hall Davis, M.D., Physician to the Royal Maternity Charity; Physician-Accoucheur to the St. George's and St. James's Dispensary; and Consulting Physician-Accoucheur to the St. Pancras Infirmary; 11, Harley street, Cavendish square.

1820 †Thomas Davis, Boxmoor House, Herts. C. 1837, 1843.

1818 James Dawson, Liverpool.

1847 George Edward Day, M.D., F.R.S., Chandos Professor of Anatomy, and Examiner in Medicine in the University of St. Andrew's.

1858 Teofilo Delima, M.D., Caracas, Venezuela, South America.

1846 *Samuel Best Denton, M.D., Ivy Lodge, Hornsea, Hull.

1859 William Howship Dickinson, M.D., Curator of the Pathological Museum at St. George's Hospital; Assistant-Physician to the Hospital for Sick Children; 11, Chesterfield street, May fair. *Trans.* 4.

Elected

1844 Robert Dickson, M.D., F.L.S., Physician to the Scottish Hospital; 16, Hertford street, May fair. C. 1860.

1839 †James Dixon, Surgeon to the Royal London Ophthalmic Hospital, Moorfields; and Consulting Ophthalmic Surgeon to the Asylum for Idiots; 2, Portman square, L. 1849-55. V.P. 1857-8. *Trans.* 4.

1862 Horace B. Dobell, M.D., Physician to the Royal Infirmary for Diseases of the Chest, City road; 29, Duncan terrace, City road.

1845 John Dodd.

1857 Archibald Douglas, M.D., 8 Clifton place, Sussex square, Hyde park.

1853 Robert Druitt, M.R.C.P., Medical Officer of Health for St. George's, Hanover square; 37, Hertford street, May fair. *Trans.* 2.

1846 John Drummond, Inspector General of Fleets and Hospitals; Dover. *Trans.* 1.

1845 George Duff, M.D., High street, Elgin.

1845 Edward Willson Duffin, 18, Devonshire street, Portland place. *Trans.* 1.

1833 Robert Dunn, 31, Norfolk-street, Strand. C. 1845-6; *Trans.* 2.

1861 Claudius Francis Du Pasquier, Surgeon-Apothecary in Ordinary to Her Majesty the Queen; 62, Pall Mall.

1843 Christopher Mercer Durrant, M.D., Physician to the East Suffolk and Ipswich Hospital; Ipswich, Suffolk.

1839 Henry Sumner Dyer, M.D., 37, Bryanston sq. C. 1854-5.

1836 James William Earle, late of Norwich.

1824 George Edwards.

1823 Charles Chandler Egerton, Kendall Lodge, Epping.

1861 *Robert Elliot, M.D., 18, Lowther street, Carlisle.

1848 George Viner Ellis, Professor of Anatomy in University College, London; University College, Gower street. *Trans.* 2.

1851 *James Ellison, M.D., Surgeon in Ordinary to the Royal Household, Windsor; 14, High street, Windsor.

1835 William England, M.D., Ipswich, Suffolk.

Elected

1842 JOHN ERICHSEN, Professor of Surgery in University College, London, and Surgeon to University College Hospital; 6, Cavendish place, Cavendish square. C. 1855-6. *Trans.* 2.

1836 GEORGE FABIAN EVANS, M.D., Physician to the General Hospital, Birmingham.

1815 *GRIFFITH FRANCIS DORSETT EVANS, M.D., Trewern lodge, 43, Addison road, Kensington. C. 1838.

1845 WILLIAM JULIAN EVANS, M.D., Pinner, Middlesex.

1858 RANDLE WILBRAHAM FALCONER, M.D., Physician to the Bath United Hospital; 22, Bennett street, Bath.

1862 ROBERT FARQUHARSON, M.D., Coldstream Guards' Hospital, Vincent square, Westminster.

1844 ARTHUR FARRE, M.D., F.R.S., Professor of Midwifery in King's College, London, and Physician for the Diseases of Women and Children to King's College Hospital; 12, Hertford street, May fair. C. 1857.

1831 ROBERT FERGUSON, M.D., Physician Extraordinary to H.M. the Queen, and Consulting Physician to King's College Hospital; 125, Park street, Grosvenor square. C. 1839. V.P. 1847.

1841 WILLIAM FERGUSSON, F.R.S., Surgeon Extraordinary to H.M. the Queen; Professor of Surgery in King's College, London, and Surgeon to King's College Hospital; Examiner in Surgery at the University of London; 16, George street, Hanover square. C. 1849-50. *Trans.* 4.

1852 *ALFRED GEORGE FIELD, Surgeon to St. Mary's Hospital, Brighton; 28, Old Steine, Brighton.

1849 GEORGE TUPMAN FINCHAM, M.D., Physician to, and Lecturer on Medical Jurisprudence at, the Westminster Hospital; 2, Eccleston terrace south, Eccleston square.

1836 SIR JOHN WILLIAM FISHER, Surgeon-in-Chief to the Metropolitan Police Force; 5, Grosvenor gate. C. 1843-4.

1860 THOMAS GEORGE FITZGERALD, Staff-Surgeon; 6, Whitehall yard.

1842 THOMAS BELL ELCOCK FLETCHER, M.D., Physician to the Birmingham General Hospital; Waterloo street, Birmingham. *Trans.* 1.

Elected

1859 William Henry Flower, Conservator of the Museum at the Royal College of Surgeons of England. *Trans.* 1.

1848 John Gregory Forbes, Surgeon to the Metropolitan Convalescent Institution; 9, Devonport street, Hyde park. *Trans.* 2.

1852 †John Cooper Forster, Assistant Surgeon to, and Lecturer on Anatomy at, Guy's Hospital; Surgeon to the Royal Infirmary for Children, &c.; 11, Wellington street, Southwark. *Pro.* 1.

1859 Edward Long Fox, M.B., Physician to the Bristol Royal Infirmary; 10, Berkeley square, Bristol.

1858 *Wilson Fox, M.D., Professor of Pathology at University College, London; 22B, Cavendish square.

1841 John Christopher Augustus Franz, M.D.

1843 Patrick Fraser, M.D., Physician to the London Hospital, and to the London Dispensary; 63, Grosvenor street.

1836 †John George French, Surgeon to the St. James's Infirmary; 41, Great Marlborough street. C. 1852-3.

1849 Robert Temple Frere, M.A., F.R.C.P., 34, Upper Harley street.

1846 Henry William Fuller, M.D., Physician to, and Lecturer on Medical Jurisprudence at, St. George's Hospital; 13, Manchester square. C. 1862. *Trans.* 2.

1815 *George Frederick Furnivall, Medical Attendant of Great Foster House Asylum for Lunatics; Egham, Surrey.

1860 Robert Cameron Galton, M.D., 48, Harley street.

1854 Alfred Baring Garrod, M.D., F.R.S., Examiner in Materia Medica at the University of London; Professor of Materia Medica, Therapeutics, and Clinical Medicine in University College, London, and Physician to University College Hospital; 84, Harley street, Cavendish square. *Trans.* 8.

1857 George Green Gascoyen, Assistant-Surgeon to the Lock Hospital, and Lecturer on Descriptive and Surgical Anatomy in the St. Mary's Hospital Medical School; 18, Queen Anne Street, Cavendish square. *Trans.* 1.

Elected

1851 George Gaskoin, 3, Westbourne park.

1819 Henry Gaulter.

1848 John Gay, Senior Surgeon to the Great Northern Hospital, and Consulting Surgeon to the Asylum for Idiots; 10, Finsbury place south.

1821 *Richard Francis George, late Senior Surgeon to the Bath General Hospital; 10, Royal Crescent, Bath.

1858 Benjamin Godfrey, M.D., Carlton House, Enfield, Middlesex.

1851 Stephen Jennings Goodfellow, M.D., Physician to, and Lecturer on Medicine at, the Middlesex Hospital; 5, Savile row, Burlington gardens. *Trans.* 2.

1818 James Alexander Gordon, M.D., C.B., F.R.S., Parham House, Dorking. C. 1828. V.P. 1829. *Trans.* 1.

1862 John G. Goulstone, M.D., Chief Surgeon to the Great Eastern Steamship, Bellevue, Shrewsbury.

1851 Peter Yeames Gowlland, Surgeon to St. Mark's Hospital; 34, Finsbury square.

1844 John Grantham, Crayford, Kent.

1846 George Thompson Gream, M.D., 2, Upper Brook street, Grosvenor square.

1816 Joseph Henry Green, D.C.L., F.R.S., President of the Medical Council; Consulting Surgeon to St. Thomas's Hospital; Hadley, Middlesex. C. 1820. V.P. 1830. *Trans.* 1.

1843 Robert Greenhalgh, M.D., Physician-Accoucheur to, and Lecturer on Midwifery at, St. Bartholomew's Hospital, and Physician-Accoucheur to the Samaritan Free Hospital for Women and Children; 76, Grosvenor street.

1860 Edward Headlam Greenhow, M.D., Assistant-Physician to, and Lecturer on Public Health and on Medical Jurisprudence at, the Middlesex Hospital, and Consulting Physician to the Western General Dispensary; 77, Upper Berkeley street, Portman square. *Trans.* 1.

1814 John Grove, M.D., Salisbury.

1852 John Grove, West Hill, Wandsworth, Surrey.

Elected

1860 Henri Gueneau de Mussy, M.D., 4, Cavendish place, Cavendish square.

1849 William Withey Gull, M.D., Physician to, and Lecturer on Medicine at, Guy's Hospital; Member of the Senate of the University of London; 26, Brook street, Grosvenor square. *Trans.* 2.

1837 James Manby Gully, M.D.; Great Malvern, Worcestershire.

1859 Theophilus Miller Gunn; 40, York place, Portman square.

1819 John Gunning, C.B., Inspector-General of Hospitals; Paris. C. 1823.

1854 Samuel Osborne Habershon, M.D., Assistant-Physician to, and Lecturer on Materia Medica and Therapeutics at, Guy's Hospital; 22, Wimpole street, Cavendish square. *Trans.* 1.

1849 Hammett Hailey, Newport Pagnell, Bucks.

1845 Sir John Hall, M.D., K.C.B., Inspector-General of Hospitals.

1848 Alexander Halley, M.D., F.G.S., 7, Harley street, Cavendish square.

1819 †Thomas Hammerton, 112, Piccadilly. C. 1829-30.

1838 Henry Hancock, Surgeon to, and Lecturer on Surgery at, the Charing Cross Hospital; Surgeon to the Royal Westminster Ophthalmic Hospital; 37, Harley street, Cavendish square. C. 1851.

1849 *Richard James Hansard, Surgeon to the Radcliffe Infirmary, Oxford.

1848 *George Harcourt, M.D., Chertsey, Surrey.

1836 John Fosse Harding, Sandford House, Highbury New Park. C. 1858-9.

1856 Charles John Hare, M.D., Physician to University College Hospital; 41, Brook street, Grosvenor square.

1857 George Harley, M.D., F.C.S., Professor of Medical Jurisprudence in University College, London; 77, Harley street, Cavendish square.

Elected

1859 Francis Harris, M.D., Assistant-Physician to, and Lecturer on Botany at, St. Bartholomew's Hospital; Assistant-Physician to the Hospital for Sick Children; 24, Cavendish square.

1846 John Harrison, 2, the Court yard, Albany.

1843 Thomas Sunderland Harrison, M.D., F.L.S., Innox Hill House, Frome, Somersetshire.

1841 William Harvey, Surgeon to the Royal Dispensary for Diseases of the Ear, and to the Freemasons' Female Charity, and Aural Surgeon to the Great Northern Hospital; 2, Soho square. C. 1854.

1855 Alfred Haviland, Surgeon to the Bridgewater Infirmary; Bridgewater, Somerset.

1828 †Cæsar Henry Hawkins, F.R.S., President of the Royal College of Surgeons; Surgeon Extraordinary to H.M. the Queen, and Consulting Surgeon to St. George's Hospital; 26, Grosvenor street. C. 1830-1, 1860. V.P. 1838-9. T. 1841-4. P. 1855-6. *Trans.* 12.

1838 Charles Hawkins, *Treasurer*, Inspector of Anatomy; Consulting Surgeon to Queen Charlotte's Hospital; 22, Savile row, Burlington gardens. C. 1846-7. S. 1850. V.P. 1858. T. 1861-2. *Trans.* 2.

1848 Thomas Hawksley, M.D., Physician to the Margaret street Dispensary for Consumption and Diseases of the Chest; 26, George street, Hanover square.

1860 Henry Howard Hayward, 56, Queen Anne street, Cavendish square.

1861 William Henry Hayward, Church House, Oldbury, near Birmingham.

1820 Thomas Emerson Headlam, M.D., Consulting Physician to the Newcastle Infirmary, Newcastle-upon-Tyne.

1848 *James Newton Heale, M.D., Physician to the Winchester County Hospital; Winchester, Hants.

1850 George Heaton, M.D., Boston, U.S.

1829 †Thomas Heberden, M.D., 43, Park street, Grosvenor square.

1844 John Hennen, M.D. L. 1848-50.

Elected

1849 Amos Henriques, M.D., Hon. Physician to the Spanish Embassy; 67, Upper Berkeley street, Portman square.

1848 Mitchell Henry, Surgeon to, and Lecturer on Medical Jurisprudence at, the Middlesex Hospital; 5, Harley street, Cavendish square. C. 1862. *Trans.* 2.

1821 Vincent Herberski, M.D., Professor of Medicine in the University of Wilna.

1843 Prescott Gardner Hewett, Surgeon to St. George's Hospital; 1, Chesterfield street, May fair. C. 1859. *Trans.* 7.

1855 Graily Hewitt, M.D., Physician to the British Lying-in Hospital; Lecturer on Midwifery and the Diseases of Women and Children at St. Mary's Hospital; 36, Berkeley square.

1853 Thomas Hewlett, Surgeon to Harrow School; Harrow, Middlesex. *Trans.* 1.

1841 *Nathaniel Highmore, Sherborne, Dorsetshire.

1854 Thomas Hillier, M.D., Physician to the Hospital for Sick Children; Medical Officer to the Skin Department of University College Hospital, and Medical Officer of Health for St. Pancras; 21, Upper Gower street.

1842 William Augustus Hillman, Senior Assistant-Surgeon to the Westminster Hospital; 1, Argyll street, Regent street. C. 1858-9.

1841 †John Hilton, F.R.S., Surgeon to, and Lecturer on Surgery at, Guy's Hospital; Consulting Surgeon to the Royal General Dispensary, St. Pancras; Professor of Anatomy and Surgery at the Royal College of Surgeons; 10, New Broad street, City. C. 1851. *Trans.* 3.

1859 Francis Hird, Assistant-Surgeon to, and Lecturer at, the Charing Cross Hospital; 17, Clifford street, Bond street.

1840 Thomas Hodgkin, M.D., *Vice-President*, Consulting Physician to the Hospital for Diseases of the Skin, and Member of the Senate of the University of London; 35, Bedford square. C. 1842-3. *Trans.* 6.

1813 Joseph Hodgson, F.R.S., 60, Westbourne terrace, Hyde park gardens. C. 1817. P. 1851-2. *Trans.* 1.

1861 *William Carter Hoffmeister, M.D., Surgeon to H.M. the Queen in the Isle of Wight; Cowes, Isle of Wight.

Elected

1843 Luther Holden, Assistant-Surgeon to, and Lecturer on Anatomy at, St. Bartholomew's Hospital; Surgeon to the Metropolitan Dispensary; 54, Gower street, Bedford square. C. 1859.

1814 †Sir Henry Holland, Bart., M.D., D.C.L., LL.D., F.R.S., Physician in Ordinary to H.M. the Queen; 25, Brook street, Grosvenor square. C. 1817, 1833-4. V.P. 1826, 1840. *Trans.* 1.

1861 William Henry Holman, M.B. Lond.; 9, Chalcot's villas, Adelaide road, Haverstock hill.

1856 Timothy Holmes, Assistant-Surgeon to, and Lecturer on Anatomy, &c. at, St. George's Hospital, and Surgeon to the Hospital for Sick Children; 22, Queen street, May fair. *Trans.* 2.

1846 Barnard Wight Holt, Senior Surgeon to, and Lecturer on Clinical Surgery at, the Westminster Hospital; Medical Officer of Health for Westminster; 14, Savile row, Burlington gardens. C. 1862.

1846 Carsten Holthouse, Surgeon to, and Lecturer on Anatomy at, the Westminster Hospital; Surgeon to the South London Ophthalmic Hospital; 2, Storey's gate, St. James's park.

1853 William Charles Hood, M.D., F.L.S., Resident Physician, and Medical Superintendent of Bethlem Hospital. *Trans.* 1.

1828 *Edward Howell, M.D., Senior Consulting Physician to the Swansea Infirmary; 2, South Hill place, Swansea, Glamorganshire.

1857 John Whitaker Hulke, Assistant-Surgeon to the Middlesex Hospital, and Surgeon to the Royal London Ophthalmic Hospital, Moorfields; 10, Old Burlington street. *Trans.* 2.

1857 Edward Charles Hulme, Surgeon to the Great Northern Hospital, Surgeon to the Central London Ophthalmic Hospital; 19, Gower street, Bedford square. *Trans.* 1.

1844 Edwin Humby, 83, Hamilton terrace, St. John's wood.

Elected

1855 George Murray Humphry, M.D., F.R.S., Surgeon to Addenbrooke's Hospital, and Lecturer on Anatomy in the Cambridge University Medical School; Cambridge. *Trans.* 4.

1849 Edward Law Hussey, Surgeon to the Radcliffe Infirmary; St. Aldate's, Oxford. *Trans.* 1.

1856 Jonathan Hutchinson, Assistant-Surgeon to, and Joint Lecturer on Surgery at, the London Hospital; Assistant-Surgeon to the Royal London Ophthalmic Hospital, Moorfields; Surgeon to the Metropolitan Free Hospital; 4, Finsbury circus. *Pro.* 2.

1820 William Hutchinson, M.D.

1840 Charles Hutton, M.D., Physician to the General Lying-in Hospital, and to the Royal Infirmary for Children and Women; 26, Lowndes street, Belgrave square. C. 1858-9.

1847 William Edmund Image, Senior Surgeon to the Suffolk General Hospital; Bury St. Edmund's, Suffolk. *Trans.* 1.

1856 Cornelius Inglis, M.D.

1826 William Ingram, Midhurst, Sussex.

1845 *Henry Jackson, Senior Surgeon to the Sheffield General Infirmary; St. James's row, Sheffield, Yorkshire.

1841 Paul Jackson, 24, Wimpole street, Cavendish square. C. 1862.

1841 Maximilien Morris Jacobovics, M.D., Vienna.

1825 John B. James, M.D.

1847 *William Withall James, Surgeon to the Devon and Exeter Hospital; Exeter, Devonshire.

1844 Samuel John Jeaffreson, M.D., Physician to the Warneford Hospital, and Warwick Dispensary; Leamington, Warwickshire.

1839 Julius Jeffreys, F.R.S., Kingston, Surrey.

1840 *George Samuel Jenks, M.D., 18, Circus, Bath.

Elected

1851 William Jenner, M.D., Physician in Ordinary to H.M. the Queen; Examiner in Medicine at the University of London; Physician to University College Hospital, and Professor of the Principles and Practice of Medicine at University College; Physician to the Hospital for Sick Children; 8, Harley street, Cavendish square. *Trans.* 3.

1848 Athol Archibald Wood Johnson, 20, Regency square, Brighton. *Trans.* 1.

1851 Edmund Charles Johnson, M.D., Corresponding Member of the Imperial Society of Florence; 6, Savile row.

1847 George Johnson, M.D., Professor of the Principles and Practice of Medicine in King's College, London, and Physician to King's College Hospital; 11, Savile row, Burlington gardens. C. 1862. *Trans.* 5.

1837 Henry Charles Johnson, Surgeon to St. George's Hospital; 6, Savile row, Burlington gardens. C. 1850-1. V.P. 1860-1.

1862 Charles Handfield Jones, M.B., F.R.S., Physician to St. Mary's Hospital; 49, Green street, Grosvenor square.

1844 †Henry Bence Jones, M.A., M.D., F.R.S.; 31, Brook street, Grosvenor square. C. 1855-6. *Trans.* 11.

1835 Henry Derviche Jones, 12, Norfolk crescent, Hyde park. C. 1854-5.

1853 Thomas Wharton Jones, F.R.S., Professor of Ophthalmic Surgery in University College, London, and Ophthalmic Surgeon to University College Hospital; 35, George street, Hanover square. *Trans.* 1.

1837 Thomas William Jones, M.D., 19, Finsbury pavement. C. 1858.

1859 William Price Jones, M.D., Surbiton, Kingston.

1829 *George Charles Julius, Richmond, Surrey.

1816 *George Hermann Kauffmann, M.D., Hanover.

1848 *Daniel Burton Kendell, M.D., Kettlethorpe Hall, Wakefield, Yorkshire.

1847 Alfred Keyser, 21, Norfolk crescent, Oxford square.

1857 Henry Walter Kiallmark, late Staff Surgeon, 2nd class, attached to the Ottoman Army; 46, Prince's square, Westbourne grove.

Elected

1839 *David King, M.D., Medical Officer of Health for Eltham; Eltham, Kent.

1851 John Abernethy Kingdon, Surgeon to the City of London Truss Society, and to the City Dispensary; 2, New Bank buildings, City.

1858 William Senhouse Kirkes, M.D., Assistant-Physician to, and Lecturer on Medicine at, St. Bartholomew's Hospital; 2, Lower Seymour street, Portman square. *Trans.* 1.

1855 James Robert Lane, Surgeon to, and Lecturer on Operative Surgery at, St. Mary's Hospital, and Surgeon to the Lock and St. Mark's Hospitals; 1, Grosvenor place.

1840 Samuel Armstrong Lane, Surgeon to, and Lecturer on Surgery at, St. Mary's Hospital, and Consulting Surgeon to the Lock Hospital; 1, Grosvenor place. C. 1849-50.

1841 *Charles Lashmar, M.D., 83, North End, Croydon, Surrey.

1816 G. E. Lawrence.

1809 †William Lawrence, F.R.S., Serjeant-Surgeon to H.M. the Queen; Surgeon to, and Lecturer on Surgery at, St. Bartholomew's Hospital, and Surgeon to Bridewell and Bethlem Hospital; Foreign Associate of the Imperial Academy of Medicine of Paris; 18, Whitehall place. S. 1813-7. V.P. 1818-9. T. 1821-6. P. 1831-2. C. 1820, 1833-4, 1842-3. *Trans.* 18.

1840 Thomas Laycock, M.D., F.R.S.E., Professor of the Practice of Medicine in the University of Edinburgh, and Physician to the Edinburgh Royal Infirmary; 4, Rutland street, Edinburgh.

1843 *Jesse Leach, Moss Hall, Heywood, near Bury, Lancashire.

1822 John Joseph Ledsam, M.D., 17, Esplanade, Scarborough, Yorkshire.

1823 †Henry Lee, M.D., Weather Oak, Alvechurch, near Bromsgrove, Worcestershire. C. 1837. S. 1839-40.

Elected

1843 Henry Lee, Assistant-Surgeon to, and Lecturer on Pathology at, St. George's Hospital, and Senior Surgeon to the Lock Hospital; 9, Savile row, Burlington gardens. C. 1856-7 *Trans.* 7. *Pro.* 1.

1822 †Robert Lee, M.D., F.R.S., Obstetric Physician to, and Lecturer on Midwifery at, St. George's Hospital; Corresponding Member of the Imperial Academy of Medicine, Paris; 4, Savile row, Burlington gardens. C. 1829, 1834. S. 1830-3. V.P. 1835. *Trans.* 21.

1836 Frederick Leighton, M.D., Frankfort-on-the-Maine.

1854 Hananel de Leon, M.D., Bronsham road, Bedford.

1856 David Lewis, M.D., Physician to the Royal Society of Ancient Britons' Schools.

1847 Sir John Liddell, M.D., C.B., F.R.S., Hon. Physician to H.M. the Queen, Director-General of the Medical Department of the Navy; Admiralty, Somerset House, and 72, Chester square, Belgravia.

1806 John Lind, M.D.

1845 William John Little, M.D., Physician to the London Hospital; 34, Brook street, Grosvenor square.

1819 Robert Lloyd, M.D.

1820 J. G. Locher, M.C.D., Town Physician of Zurich. *Trans.* 2.

1824 †Sir Charles Locock, Bart., M.D., First Physician-Accoucheur to H.M. the Queen, and Consulting Physician to the General Lying-in Hospital; Member of the Senate of the University of London; 26, Hertford street, May fair. C. 1826. V.P. 1841. P. 1857-8. *Trans.* 1.

1852 Charles Lodge, M.D.

1846 Henry Thomas Lomax, Surgeon to the County Police; St. Mary's grove, Stafford.

1860 Thomas Longmore, Deputy Inspector-General and Professor of Clinical and Military Surgery; New Army Medical School, Chatham.

1836 Joseph S. Löwenfeld, M.D., Berbice.

1852 James Luke, F.R.S., Consulting Surgeon to the London Hospital, and Surgeon to St. Luke's Hospital for Lunatics; 37, Broad street buildings, City. C. 1858. *Trans.* 4.

Elected

1857 Felix William Lyon, M.D., Lyndhurst, Hants.

1846 William M'Ewen, M.D., Surgeon to Chester Castle; 27, Nicholas street, Chester.

1862 *Robert M'Donnell, M.D., 11, Lower Pembroke street, Dublin.

1823 †George Macilwain, Consulting Surgeon to the Finsbury Dispensary and the St. Ann's Society's Schools; 3, the Court yard, Albany. C. 1829-30. V.P. 1848. *Trans.* 1.

1822 Richard Mackintosh, M.D.

1859 *John M'Intyre, M.D., Odiham, Hants.

1848 Frederick William Mackenzie, M.D., Physician to Queen Charlotte's Lying-in Hospital; Senior Physician to the Western General Dispensary; 11, Chester place, Hyde park square. *Trans.* 2.

1818 William Mackenzie, M.D., Surgeon-Oculist to H.M. the Queen in Scotland, and Surgeon to the Glasgow Eye Infirmary; 49, Bath street, Glasgow. *Trans.* 2.

1854 *Draper Mackinder, M.D., Consulting Surgeon to the Dispensary, Gainsborough, Lincolnshire.

1844 Daniel Maclachlan, M.D., Physician to the Royal Hospital, Chelsea, and Deputy Inspector-General of Hospitals; Royal Hospital, Chelsea. C. 1860-1. *Trans.* 1.

1860 John Maclean, M.D., 24, Portman street, Portman square.

1851 Samuel Maclean, 68, Wimpole street, Cavendish square.

1849 Duncan Maclachlan Maclure, 16, Harley street, Cavendish square.

1842 John Macnaught, M.D., Bedford street, Liverpool.

1837 Andrew Melville M'Whinnie, Assistant-Surgeon to the London Hospital for Diseases of the Skin, Blackfriars; 5, Crescent, New Bridge street, Blackfriars. C. 1851-2. *Trans.* 1.

1855 William Marcet, M.D., F.R.S., Assistant-Physician to, and Lecturer on Chemistry at, the Westminster Hospital; 4, George street, Hanover square. *Trans.* 1.

1848 William Orlando Markham, M.D., Physician to St. Mary's Hospital; 33, Clarges street, Piccadilly. C. 1862. *Trans.* 2.

Elected

1838 Thomas Parr Marsh, M.D., Consulting Physician to the Salop Infirmary, Shrewsbury; Pentrewun, Gobowen, Oswestry.

1851 John Marshall, F.R.S., Surgeon to University College Hospital; Fullerian Professor of Physiology at the Royal Institution of Great Britain; 10, Savile row, Burlington gardens. *Trans.* 2.

1841 Sir James Ranald Martin, C.B., F.R.S., *Vice-President*, Examining Medical Officer to the Secretary of State for India in Council; 24, Mount street, Grosvenor square. C. 1853. V.P. 1862.

1849 George Bellasis Masfen, Ghazeepore, India.

1853 William Edward Masfen, Surgeon to the Staffordshire General Infirmary; Stafford.

1837 Thomas Mayo, M.D., F.R.S., Honorary Physician to the St. Marylebone Infirmary; 56, Wimpole street, Cavendish square. S. 1841. C. 1847-8. V.P. 1851-2.

1839 Richard Henry Meade, Senior Surgeon to the Bradford Infirmary; Bradford, Yorkshire. *Trans.* 1.

1837 Samuel William John Merriman, M.D., Consulting Physician-Accoucheur to the Westminster General Dispensary, and Physician-Accoucheur to the Western General Dispensary; 3, Charles street, Westbourne terrace. C. 1851-2. *Trans.* 1.

1852 James Merryweather, Consulting Surgeon to the National Dental Hospital; 57, Brook street, Grosvenor square.

1847 Edward Meryon, M.D., F.G.S., 14, Clarges street, Piccadilly. L. 1859-60. *Trans.* 1.

1815 Augustus Meyer, M.D., St. Petersburgh.

1840 Richard Middlemore, Consulting Surgeon to the Birmingham Eye Infirmary; Temple row, Birmingham.

1854 Edward Archibald Middleship, late of Richmond, Surrey.

1860 *Herbert Chalmers Miles, Assistant-Surgeon in the Royal Artillery; Montreal, Canada east; and 17, Whitehall place.

1818 *Patrick Miller, M.D., F.R.S.E., Senior Physician to the Devon and Exeter Hospital, and to St. Thomas's Hospital for Lunatics; the Grove, Exeter, Devonshire.

Elected

1844 Nathaniel Montefiore, 36, Hyde park gardens.

1848 Charles Hewitt Moore, *Secretary*, Surgeon to, and Lecturer on Anatomy at, the Middlesex Hospital; 102, Piccadilly. L. 1858. S. 1859-62. *Trans.* 4.

1836 George Moore, M.D., Hastings, Sussex.

1861 Charles Morehead, M.D., Hon. Surgeon to H.M. the Queen; late Principal of Grant Medical College, Bombay, &c.; 20, Chapel street, Grosvenor square.

1861 John Edward Morgan, M.B., 33, King street, Manchester.

1857 John Morgan, 3 Sussex place, Hyde park gardens.

1851 Frederick John Mouat, M.D., Professor of Medicine in the Medical College of Calcutta, Secretary of the Council of Education in India, and Inspector-General of Gaols, Lower Provinces; Calcutta.

1856 Charles Murchison, M.D., Senior Physician to the London Fever Hospital; Assistant-Physician to, and Lecturer on Pathological Anatomy at, the Middlesex Hospital; 79, Wimpole street, Cavendish square, *Trans.* 2.

1847 Simon Murchison, Bicester, Oxon.

1859 George Nayler, Demonstrator of Anatomy at St. George's Hospital; 30, Clarendon gardens, Maida hill.

1835 Thomas Andrew Nelson, M.D., 10, Nottingham terrace, York gate, Regent's park.

1843 Edward Newton, 30, Fitzroy square.

1851 James Nichols, M.D., 13, Savile row, Burlington gardens.

1849 Henry Burford Norman, Portland Lodge, Southsea, Hants.

1845 Henry Norris, Charmouth, Dorset.

1847 *William Edward Charles Nourse, Assistant-Surgeon to St. Mary's Hospital, Brighton; 11, Old Steine, Brighton.

1849 Arthur Noverre, 25, South street, Park lane.

1859 *Thomas Nunneley, Senior Surgeon to the Leeds Eye and Ear Infirmary; Leeds. *Trans.* 2.

1847 Thomas O'Connor, March, Cambridgeshire.

1843 William O'Connor, M.D., Physician to the Royal Free Hospital; 30, Upper Montagu street, Montagu square.

Elected

1858 William Mackay Ogilvie, Surgeon, R.N.

1858 John William Ogle, M.D., Assistant-Physician to St. George's Hospital; 13, Upper Brook street, Grosvenor square. *Trans.* 3.

1855 *William Ogle, M.A., M.D., Physician to the Derby Infirmary; 3, Stewart terrace, Derby.

1860 William Ogle, M.D., 37, Clarges street, Piccadilly, W.

1850 Henry Oldham, M.D., Obstetric Physician to, and Clinical Lecturer on Midwifery at, Guy's Hospital, and Obstetric Physician to the Tower Hamlets Dispensary; 26, Finsbury square. *Trans.* 1.

1846 *Edward Latham Ormerod, M.D., Physician to the Sussex County Hospital; 14, Old Steine, Brighton. *Trans.* 2.

1847 *William Bousfield Page, Surgeon to the Cumberland Infirmary; Carlisle. *Trans.* 2.

1840 James Paget, V.P.R.S., Surgeon Extraordinary to H.M. the Queen; Surgeon to St. Bartholomew's Hospital, and Member of the Senate of the University of London; 1, Harewood place, Hanover square. C. 1848-9. V.P. 1861. *Trans.* 8.

1858 *William Paley, M.D., Physician to the Ripon Dispensary; Ripon, Yorkshire.

1861 James Palfrey, M.D., Assistant-Physician to the Metropolitan Free Hospital; 12, Wellington street, Southwark.

1836 Langston Parker, Hon. Surgeon to the Queen's Hospital, Birmingham; Colmore row, Birmingham.

1847 Nicholas Parker, M.D., Assistant-Physician to, and Lecturer on Medicine at, the London Hospital; 22, Finsbury square.

1811 John Parkin, M.D., Rome.

1851 James Part, M.D., 7, Camden road villas, Camden town.

1828 †Richard Partridge, F.R.S., Professor of Anatomy to the Royal Academy of Arts, Surgeon to King's College Hospital, and Professor of Anatomy in King's College, London; 17, New street, Spring gardens. S. 1832-6. C. 1837-8. V.P. 1847-8. C. 1861-2.

Elected

1845 Thomas Bevill Peacock, M.D., Physician to, and Lecturer on Medicine at, St. Thomas's Hospital; Physician to the City of London Hospital for Diseases of the Chest, Victoria park; 20, Finsbury circus. S. 1855-6. *Trans.* 2.

1856 Richard King Peirce, 16, Norland place, Notting hill.

1830 Charles P. Pelechin, M.D., St. Petersburgh.

1855 *Oliver Pemberton, Surgeon to the Birmingham General Hospital, and Lecturer on Surgical Pathology at Sydenham College; 18, Temple row, Birmingham. *Trans.* 1.

1844 William Vesalius Pettigrew, M.D., Surgeon to the Female Orphan Asylum, Lambeth; 7, Chester street, Grosvenor place.

1848 Edward Phillips, M.D., F.L.S., Physician to the Coventry and Warwickshire Hospital; Coventry, Warwickshire.

1852 Richard Phillips, 52, Leinster square, Westbourne grove.

1854 Thomas Bacon Phillips, M.D., Physician to the Brighton and Hove Dispensary; 36, Lansdowne place, Brighton.

1846 Francis Richard Philp, M.D., Colby House, Kensington.

1851 *James Hollins Pickford, M.D., M.R.I.A., 1, Cavendish place, Brighton.

1836 Isaac Pidduck, M.D., Physician to the Bloomsbury Dispensary; 22, Montague street, Russell square. *Pro.* 2.

1852 Henry Pilleau, Deputy Inspector-General of Hospitals (India).

1841 Henry Alfred Pitman, M.D., Physician to, and Lecturer on Medicine at, St. George's Hospital; Consulting Physician to the Royal General Dispensary, St. Pancras; 91, Gloucester place, Portman square. L. 1851-3. C. 1861-2.

1850 Alfred Poland, Surgeon to Guy's Hospital and to the Eye Infirmary attached to the Hospital; 58, Welbeck street, Cavendish square.

1845 George David Pollock, F.L.S., *Librarian*, Surgeon to, and Lecturer on Anatomy at, St. George's Hospital; 27, Grosvenor street. C. 1856-7. L. 1859-62. *Trans.* 2.

1843 Charles Pope, M.D., Glastonbury, Somersetshire.

Elected

1846 Jephson Potter, M.D., F.L.S., 109, Upper Parliament street, Liverpool.

1842 James Powell, M.B.

1851 Robert Francis Power, M.D., 7, Lower Grosvenor place.

1857 William Overend Priestley, M.D., Physician-Accoucheur to, and Lecturer on Midwifery at, the Middlesex Hospital; Physician-Accoucheur to the St. Marylebone Infirmary; 17, Hertford street, May fair.

1839 John Propert, Consulting Surgeon to the Society of Ancient Britons; 6, New Cavendish street, Portland place.

1845 John Pyle, 56, Oxford terrace, Hyde park. C. 1860.

1830 Jones Quain, M.D., Paris.

1850 Richard Quain, M.D., Physician to the Hospital for Consumption and Diseases of the Chest, and Member of the Senate of the University of London; 56, Harley street, Cavendish square. *Trans.* 1.

1835 †Richard Quain, F.R.S., Professor of Clinical Surgery in University College, London, and Surgeon to University College Hospital; Consulting Surgeon to the Eye Infirmary attached to the Hospital; 32, Cavendish square. C. 1838-9. L. 1846-8. T. 1851-3. V.P. 1856–7. *Trans.* 1. *Pro.* 2.

1852 Charles Bland Radcliffe, M.D., Physician to, and Lecturer on Materia Medica at, the Westminster Hospital; 4, Henrietta street, Cavendish square.

1857 Henry Ranke, M.D., Munich.

1854 William Henry Ransom, M.D., Physician to the Nottingham General Hospital; Nottingham.

1859 Henry Hunter Raymond, Cirencester, Gloucestershire.

1858 Frederick George Reed, M.D., 46, Hertford street, May fair. *Trans.* 1.

1821 Henry Reeder, M.D.

1857 George Owen Rees, M.D., F.R.S., Physician to, and Lecturer on Medicine at, Guy's Hospital; Examiner in Materia Medica at the University of London; 26, Albemarle street, Piccadilly. *Trans.* 1.

Elected

1855 John Russell Reynolds, M.D., Professor of Clinical Medicine at University College, London, and Physician to University College Hospital; 38, Grosvenor street.

1847 Samuel Richards, M.D., 36, Bedford square.

1852 Christopher Thomas Richardson, M.B., 16, Hinde street, Manchester square.

1829 Sir John Richardson, Knt., M.D., LL.D., C.B., F.R.S., Inspector of Hospitals and Fleets; Lancrigg, Grasmere, Westmoreland.

1849 *William Richardson, M.D., 9, Ephraim road, Tunbridge Wells, Kent.

1845 Benjamin Ridge, M.D., 21, Bruton street, Berkeley square.

1843 Joseph Ridge, M.D., 39, Dorset square. C. 1858. *Pro.* 1.

1852 Charles Ridley, Surgeon to the Royal Society for Protection of Life from Fire; 6, Charlotte street, Bedford square.

1852 John Roberts, M.R.C.P., 75, Grosvenor street.

1829 *Archibald Robertson, M.D., F.R.S., 11, West mall, Clifton, Bristol.

1855 Charles Alexander Lockhart Robertson, M.D., Medical Superintendent of the Sussex County Lunatic Asylum; Hayward's Heath, Sussex.

1857 John George Robertson, Belmullet, County Mayo.

1862 Charles Robinson, Edgeware, Middlesex.

1843 George Robinson, M.D., Physician to the Newcastle-upon-Tyne Dispensary; Eldon square, Newcastle-upon-Tyne. *Trans.* 2.

1843 William Roden, M.D., the Grange, Kidderminster, Worcestershire.

1835 George Hamilton Roe, M.D., Senior Physician to the Hospital for Consumption and Diseases of the Chest; 57, Park street, Grosvenor square. C. 1841-2. *Trans.* 1.

1836 Arnold Rogers, Consulting Surgeon-Dentist to St. Bartholomew's Hospital; 16, Hanover square.

1816 William Richard Rogers, M.D., Physician to the Samaritan Free Hospital for Women and Children, and to the Western General Lying-in Institution; 56, Berners street.

Elected

1829 William Sudlow Roots, F.L.S., Surgeon to the Royal Establishment at Hampton Court; Kingston, Surrey.

1850 George Roper, 180, Shoreditch.

1836 Richard Roscoe, M.D.

1855 Thomas Tattersall Roscow, M.D.

1836 *Caleb Burrell Rose, F.G.S., 25, King street, Great Yarmouth, Norfolk. *Trans.* 1.

1857 Henry Cooper Rose, M.D., High street, Hampstead.

1849 Charles Henry Felix Routh, M.D., Physician to the Samaritan Free Hospital for Women and Children; 52, Montagu square. *Trans.* 1.

1845 Henry Mortimer Rowdon, M.D., Member of the Court of Examiners of the Society of Apothecaries; 29, Nottingham place, Marylebone road.

1834 Henry Wyldbore Rumsey, Gloucester lodge, Cheltenham.

1845 James Russell, M.D., Physician to the Birmingham General Hospital, and Lecturer on Pathology and Therapeutics at Sydenham College; 91, New Hall street, Birmingham.

1851 Henry Hyde Salter, M.D., F.R.S., Assistant-Physician to, and Lecturer on Physiology and Pathology at, the Charing Cross Hospital; 6, Montague street, Russell sq.

1856 Samuel James A. Salter, F.L.S., Surgeon-Dentist to, and Lecturer on Dental Surgery at, Guy's Hospital; 17, New Broad street, City. *Trans.* 2.

1849 Hugh James Sanderson, M.D., Physician to the Hospital for Women; 26, Upper Berkeley street, Portman square.

1855 John Burdon Sanderson, M.D., Assistant-Physician to the Hospital for Consumption; Medical Officer of Health for Paddington; Lecturer on Medical Jurisprudence at St. Mary's Hospital; 9, Gloucester place, Hyde park.

1847 William Henry Octavius Sankey, M.D., Middlesex County Lunatic Asylum, Hanwell.

1845 Edwin Saunders, Surgeon-Dentist to H.M. the Queen; 13A, George street, Hanover square.

1834 Ludwig V. Sauvan, M.D., Warsaw.

1859 William Scovell Savory, F.R.S., Assistant-Surgeon to, and Lecturer on General Anatomy and Physiology at, St. Bartholomew's Hospital; 13, Charterhouse square. *Trans.* 2.

Elected

1853 MAURICE SCHULHOF, M.D., Physician to the Royal General Dispensary, Bartholomew Close; 14, Brook street, Grosvenor square.

1861 *WILLIAM SCOTT, M.D., Physician to the Huddersfield Infirmary; 12, New North road, Huddersfield.

1858 *GEORGE SCRATCHLEY, M.D., New Orleans, Louisiana, U.S.

1856 EDWIN SERCOMBE, Surgeon-Dentist to St. Mary's Hospital; 49, Brook street, Grosvenor square. *Trans.* 1. *Pro.* 1.

1824 †EDWARD JAMES SEYMOUR, M.D., F.R.S., Consulting Physician to the Seamen's Hospital Ship 'Dreadnought; 13, Charles street, Berkeley square. C. 1826, 1831. S .1827-8. V.P. 1830, 1842. *Trans.* 2.

1840 WILLIAM SHARP, M.D., F.R.S., Horton House, Rugby. *Trans.* 1.

1837 WILLIAM SHARPEY, M.D., Sec. R.S., LL.D., *Vice-President*, Examiner in Anatomy at the University of London; Professor of Anatomy and Physiology in University College, London, and Secretary of the Royal Society; 33, Woburn place, Russell square. C. 1848-9. V.P. 1862.

1836 †ALEXANDER SHAW, Surgeon to, and Lecturer on Surgery at, the Middlesex Hospital; 22A, Cavendish square. C. 1842. S. 1843-4. V.P. 1851-2. T. 1858-60. *Trans.* 4.

1848 *EDWARD JAMES SHEARMAN, M.D., Rotherham, Yorkshire.

1859 SEPTIMUS WILLIAM SIBLEY, Lecturer on Pathological Anatomy at the Middlesex Hospital; 12, New Burlington street. *Trans.* 3.

1849 FRANCIS SIBSON, M.D., F.R.S., Physician to, and Lecturer on Medicine at, St. Mary's Hospital; 40, Brook street, Grosvenor square. *Trans.* 1.

1848 EDWARD HENRY SIEVEKING, M.D., *Secretary*, Physician to, and Lecturer on Materia Medica at, St. Mary's Hospital; 17, Manchester square. C. 1859-60. S. 1861-2. *Trans.* 2.

1842 JOHN SIMON, F.R.S., Surgeon to, and Lecturer on Pathology at, St. Thomas's Hospital; Medical Officer of the Privy Council; 44, Cumberland street, Bryanston square. C. 1854-55. *Trans.* 1.

1857 JAMES LEWIS SIORDET, M.B.

1827 GEORGE ROBERT SKENE, Bedford.

Elected

1824 †Frederic Carpenter Skey, F.R.S., Surgeon to, and Lecturer on Anatomy at, St. Bartholomew's Hospital; 13, Grosvenor street. C. 1828. L. 1829-31. V.P. 1841-2. P. 1859-60. *Trans.* 1.

1852 Charles Case Smith, Consulting Surgeon to the Suffolk General Hospital; Bury St. Edmund's, Suffolk.

1854 Edward Smith, M.D., LL.B., F.R.S., Assistant-Physician to the Hospital for Consumption and Diseases of the Chest; 16, Queen Anne street, Cavendish square. *Trans.* 5.

1835 John Gregory Smith, Harewood, Leeds, Yorkshire.

1843 Robert William Smith, M.D., M.R.I.A., Professor of Surgery in the University of Dublin; Surgeon to the Richmond Hospital; 63, Eccles street, Dublin.

1838 Spencer Smith, Surgeon to, and Lecturer on Surgery at, St. Mary's Hospital; 48, Sussex gardens, Hyde park. C. 1854. S. 1855-8. V.P. 1859-60.

1845 William Smith, Surgeon to the Chesterfield and North Derbyshire Hospital and Dispensary, Chesterfield, Derbyshire.

1847 William Smith, M.D., Consulting Physician to the Weymouth Infirmary; Weymouth, Dorsetshire.

1850 William Tyler Smith, M.D., Examiner in Midwifery at the University of London; Physician-Accoucheur to, and Lecturer on Midwifery at, St. Mary's Hospital; 21, Upper Grosvenor street. *Trans.* 2.

1851 John Soden, Surgeon to the Bath United Hospital, and Consulting Surgeon to the Bath Eye Infirmary; 24, Circus, Bath. *Trans.* 2.

1816 *John Smith Soden, 101, Sidney place, Bath. *Trans.* 1.

1830 †Samuel Solly, F.R.S., Surgeon to St. Thomas's Hospital, and Consulting Surgeon to the Royal General Dispensary, Bartholomew Close; 18, St. Helen's place, Bishopsgate street. L. 1838-40. C. 1845-6. V.P. 1849-50. *Trans.* 6.

1844 Frederick Robert Spackman, M.D., Harpenden, St. Alban's.

1834 James Spark, Italy.

Elected

1851 Robert John Spitta, M.B., Medical Officer to the Clapham General Dispensary; Clapham, Surrey. *Trans.* 1.

1843 *Stephen Spranger, Hursley, Hampshire.

1857 John Stanton, M.D., 9, Montagu square.

1851 James Startin, Surgeon to, and Lecturer on Cutaneous Disorders at, the Hospital for Diseases of the Skin, Blackfriars; 3, Savile row, Burlington gardens.

1858 Edward Stephens, M.D., Consulting Surgeon to the Manchester Lying-in Hospital; 58, Bridge street, Manchester.

1854 Henry Stevens, M.D. Lond., 78, Grosvenor street.

1842 Alexander Patrick Stewart, M.D., Physician to, and Lecturer on Medicine at, the Middlesex Hospital; 74, Grosvenor street. C. 1856-7.

1859 William Edward Stewart, 12, Weymouth street, Portland place.

1856 Alonzo Henry Stocker, M.D., Resident Medical Superintendent of Grove Hall Lunatic Asylum, Bow.

1843 Robert Reeve Storks, Paris.

1858 †John Fremlyn Streatfeild, Assistant-Surgeon to the Royal London Ophthalmic Hospital, Moorfields, and Assistant-Surgeon to the Eye Infirmary attached to University College Hospital; 15, Upper Brook street, Grosvenor square.

1839 Alexander John Sutherland, M.D., F.R.S., Consulting Physician to the Royal South London Dispensary; 6, Richmond terrace, Whitehall. C. 1850-1. V.P. 1858-9. *Trans.* 1.

1860 Sigismund Sutro, M.D., Senior Physician to the German Hospital; 37A, Finsbury square.

1855 John Maule Sutton, M.D., Physician to the Queen's Hospital, and Lecturer on Clinical Medicine at the Queen's College, Birmingham.

1861 *George Bacon Sweeting, King's Lynn, Norfolk.

1842 James Syme, F.R.S.E., Surgeon in Ordinary to H.M. the Queen in Scotland; Professor of Clinical Surgery in the University of Edinburgh, and Surgeon to the Edinburgh Royal Infirmary; 2, Rutland street, Edinburgh. *Trans.* 5.

Elected

1854 *Frederick Symonds, Surgeon to the Radcliffe Infirmary, and Consulting Surgeon to the Oxford Dispensary; 32, Beaumont street, Oxford.

1844 Richard William Tamplin, Surgeon to the Royal Orthopædic Hospital; 33, Old Burlington street.

1848 Thomas Hawkes Tanner, M.D., F.L.S., Assistant-Physician for the Diseases of Women and Children to King's College Hospital; 9, Henrietta street, Cavendish square.

1852 Robert Taylor, Surgeon to the Central London Ophthalmic Hospital, and to the Cripple's Home, Hill street; 10, George street, Hanover square.

1845 Thomas Taylor, Lecturer on Chemistry at the Middlesex Hospital Medical School; 4, Vere street, Cavendish square.

1856 Thomas Pridgin Teale, F.R.S., F.L.S., Surgeon to the Leeds General Infirmary; Albion street, Leeds. *Trans.* 2.

1859 Edward Tegart, Junior, 49, Jermyn street, St. James's.

1845 *Evan Thomas, York street, Cheetham hill road, Manchester.

1857 Henry Thompson, M.D., Physician to, and Lecturer on Materia Medica at, the Middlesex Hospital; 52, Welbeck street, Cavendish square.

1852 Henry Thompson, Consulting Surgeon to the St. Marylebone Infirmary, and Assistant-Surgeon to University College Hospital; 16, Wimpole street, Cavendish square. *Trans.* 2.

1819 †John Thomson, M.D., F.L.S., Vicarage place, Lewisham, C. 1833. L. 1834-7. V.P. 1850-1.

1850 Robert Dundas Thomson, M.D., F.R.S., Physician to the Scottish Hospital, and Medical Officer of Health for St. Marylebone; 41, York terrace, Regent's park. *Trans.* 2.

1836 John Thurnam, M.D., Resident Medical Superintendent of the Wilts County Asylum, Devizes, Wiltshire. *Trans.* 4.

1848 Edward John Tilt, M.D., Consulting Physician to the Farringdon General Dispensary and Lying-in Charity; 60, Grosvenor street.

1828 James Torrie, M.D., Old Bridge of Don, by Aberdeen.

Elected

1843 Joseph Toynbee, F.R.S., Aural Surgeon to, and Lecturer on Aural Surgery at, St. Mary's Hospital; Consulting Aural Surgeon to the Asylum for the Deaf and Dumb, and to the St. George's and St. James's Dispensary; 18, Savile row, Burlington gardens. *Trans.* 8. *Pro.* 1.

1850 Samuel John Tracy, Surgeon-Dentist to St. Bartholomew's and Christ's Hospitals; 28, Old Burlington street.

1859 Edwin Thomas Truman, Surgeon-Dentist in Ordinary to Her Majesty's Household; 23, Old Burlington street.

1862 Thomas Harrington Tuke, M.D., Manor house, Chiswick, and 37, Albemarle street.

1855 James Stewart Tulloch, M.D., 1, Pembridge place, Bayswater.

1845 Thomas Turner, F.L.S., Consulting Surgeon to the Manchester Royal Infirmary, and Lecturer on Anatomy and Physiology at the Manchester Royal School of Medicine; 77, Mosley street, Manchester.

1846 Alexander Ure, Surgeon to, and Lecturer on Clinical Surgery at, St. Mary's Hospital, and Consulting Surgeon to the Westminster General Dispensary; 18, Upper Seymour street, Portman square. *Trans.* 1.

1806 Bowyer Vaux, Teignmouth, Devon.

1810 James Vose. *Trans.* 1.

1828 Benedetto Vulpes, M.D., Physician to the Hospital of Aversa, and to the Hospital of Incurables, Naples.

1854 Edward Waddington, Surgeon to the King's Own Staffordshire Rifles; Wakefield, Yorkshire.

1841 Robert Wade, Senior Surgeon to the Westminster General Dispensary; 68, Dean street, Soho. *Trans.* 1.

1861 *James Walsh, M.R.C.P., R.N., H.M.S. Hogue, Greenock.

1852 Walter Hayle Walshe, M.D., Consulting Physician to the Hospital for Consumption; 37, Queen Anne street, Cavendish square. *Trans.* 1.

1851 Henry Haynes Walton, Surgeon to the Central London Ophthalmic Hospital, and Surgeon to St. Mary's Hospital; 69, Brook street, Hanover square. *Trans.* 1. *Pro.* 1.

Elected

1852 Daniel Wane, M.D., 20, Grafton street, Berkeley square.

1821 William Tilleard Ward.

1858 John Richard Wardell, M.D., 4, Belmont, Tunbridge Wells.

1846 James Thomas Ware, Consulting Surgeon to the Finsbury Dispensary, and Hon. Surgeon to the Metropolitan Convalescent Institution; 18, Gordon square.

1818 John Ware, Clifton, near Bristol.

1814 †Martin Ware, 18, Gordon square. C. 1844-5. T. 1846. V.P. 1853.

1829 Elias Taylor Warry, M.D., Yeovil, Somerset.

1861 A. T. H. Waters, M.R.C.P., Lecturer on Anatomy and Pathology at the Royal Infirmary School of Medicine; 27, Hope street, Liverpool. *Trans.* 1.

1837 Thomas Watson, M.D., F.R.S., D.C.L., President of the Royal College of Physicians; Physician Extraordinary to H.M. the Queen; Consulting Physician to King's College Hospital; 16, Henrietta street, Cavendish square. C. 1840-1, 1852. V.P. 1845-6.

1861 William Spencer Watson, M.B., 69, Great Russell street, Bloomsbury square.

1854 William Webb, M.D., Wirksworth, Derbyshire.

1840 William Woodham Webb, M.D., Cliff House, Kirtley, South Lowestoft, Suffolk.

1842 Frederic Weber, M.D., Assistant-Physician to the Middlesex Hospital; 44, Green street, Park lane. C. 1857.

1857 Hermann Weber, M.D., Physician to the German Hospital; 49, Finsbury square. *Trans.* 2.

1835 †John Webster, M.D., F.R.S., Physician to the Scottish Hospital, and Consulting Physician to the St. George's and St. James's Dispensary; 20, Brook street, Grosvenor square. C. 1843-4. V.P. 1855-6. *Trans.* 6.

1844 William Wegg, M.D., Physician to the St. George's and St. James's Dispensary; 49, Maddox street, Hanover square. L. 1854-8. C. 1861-2.

Elected

1861 JOHN SOELBERG WELLS, Ophthalmic Surgeon to, and Lecturer on Ophthalmic Surgery at, the Middlesex Hospital; 16, Savile row.

1854 THOMAS SPENCER WELLS, Lecturer on Surgery at the Grosvenor place School of Anatomy and Medicine, and Surgeon to the Samaritan Free Hospital for Women and Children; 3, Upper Grosvenor street. *Trans.* 1. *Pro.* 1.

1816 SIR AUGUSTUS WEST, Knt., M.D., Deputy-Inspector of Army Hospitals to the Portuguese Forces; Paris.

1842 CHARLES WEST, M.D., Examiner in Midwifery at the University of London, and Physician to the Hospital for Sick Children; 61, Wimpole street, Cavendish square. C. 1855-6. *Trans.* 2.

1841 THOMAS WEST, M.D., Daventry, Northamptonshire.

1828 JOHN WHATLEY, M.D.

1849 JOHN WHITE.

1852 JOHN WIBLIN, Medical Inspector of Emigrants and Recruits; Southampton.

1824 *WILLIAM JOHN WICKHAM, Consulting Surgeon to the Hants County Hospital; Winchester, Hants. *Trans.* 1.

1844 FREDERIC WILDBORE, 1, Trafalgar place east, Hackney road.

1837 GEORGE AUGUSTUS FREDERICK WILKS, M.D.

1860 ARTHUR WYNN WILLIAMS, M.D., 20, King street, Portman square.

1840 CHARLES JAMES BLASIUS WILLIAMS, M.D., F.R.S., Consulting Physician to the Hospital for Consumption; 49, Upper Brook street, Grosvenor square. C. 1849-50. V.P. 1860-1.

1859 *CHARLES WILLIAMS, House-Surgeon to the Norfolk and Norwich Hospital; Norwich.

1859 JOSEPH WILLIAMS, M.D., 8, Tavistock square.

1829 ROBERT WILLIS, M.D., Barnes, Surrey. L. 1838-41.

1839 †ERASMUS WILSON, F.R.S., Consulting Surgeon to the St. Pancras Infirmary; 17, Henrietta street, Cavendish square. *Trans.* 2.

1850 *ROBERT STANTON WISE, M.D., Consulting Physician to the Southam Eye and Ear Infirmary; Banbury, Oxfordshire.

Elected

1825 THOMAS ALEXANDER WISE, M.D., Rostellan Castle, Rostellan, County Cork.

1841 GEORGE LEIGHTON WOOD, Surgeon to the Bath General Hospital; 27, Queen square, Bath.

1851 JOHN WOOD, Assistant-Surgeon to King's College Hospital, and Demonstrator of Anatomy in King's College, London; 4, Montague street, Russell square. *Trans.* 1.

1848 WILLIAM WOOD, M.D., Physician to St. Luke's Hospital for Lunatics; 54, Upper Harley street.

1843 JOHN WARD WOODFALL, M.D., Physician to the West Kent Infirmary; Maidstone, Kent.

1833 †THOMAS WORMALD, Surgeon to St. Bartholomew's Hospital, and Surgeon to the Foundling Hospital; 42, Bedford row. C. 1839. V.P. 1854.

1842 WILLIAM COLLINS WORTHINGTON, Senior Surgeon to the Lowestoft Infirmary; Lowestoft, Suffolk. *Trans.* 3.

1848 EDWARD JOHN WRIGHT, 13, Montague place, Clapham road.

1855 HENRY G. WRIGHT, M.D., Physician to the Samaritan Free Hospital for Women and Children, and to the St. Pancras Royal General Dispensary; 23, Somerset street, Portman square.

1860 JOHN WYATT, Surgeon, Coldstream Guards; Vincent square, Westminster.

[It is particularly requested, that any change of Title, Appointment, or Residence, may be communicated to the Secretaries before the 1st of October in each year, in order that the List may be made as correct as possible.]

HONORARY FELLOWS.

(Limited to Twelve.)

Elected

1841 William Thomas Brande, D.C.L., F.R.S., Hon. Professor of Chemistry at the Royal Institution of Great Britain, Examiner in Chemistry, and Member of the Senate of the University of London; Royal Mint, Tower hill.

1835 Sir David Brewster, K.H., D.C.L., LL.D., F.R.S., Corresp. Memb. Institute of France, Principal and Vice-Chancellor of the University of Edinburgh.

1853 Benjamin Collins Brodie, M.A., F.R.S., Aldrichian Professor of Chemistry in the University of Oxford.

1847 Edwin Chadwick, late Commissioner of the Board of Health.

1835 Michael Faraday, D.C.L., F.R.S., Corresp. Memb. Institute of France, Member of the Senate of the University of London, and Fullerian Professor of Chemistry in the Royal Institution.

1857 William Farr, M.D., D.C.L., F.R.S., General Register Office, Somerset House.

1841 Sir John Frederick William Herschel, Bart., D.C.L., F.R.S., Corresp. Memb. Institute of France; Collingwood, near Hawkhurst, Kent.

1835 Sir William Jackson Hooker, K.H., D.C.L., LL.D., F.R.S., F.L.S., Director of the Royal Botanic Gardens, Kew; West Park, Kew.

1847 Richard Owen, D.C.L., LL.D., F.R.S., Corresp. Memb. Institute of France, (Foreign Associate of the Academy of Sciences); Superintendent of the Natural History Departments in the British Museum; Sheen Lodge, Mortlake.

1825 The Rev. Adam Sedgwick, A.M., D.C.L., F.R.S., Woodwardian Professor of Geology, Cambridge.

1841 The Rev. William Whewell, D.D., F.R.S., Master of Trinity College, Cambridge.

FOREIGN HONORARY FELLOWS.

(Limited to Twenty.)

Elected

1841 G. Andral, M.D., Member of the Institute and of the Imperial Academy of Medicine, Physician in Ordinary to the Emperor of the French, Professor of Pathology in the Faculty of Medicine; Paris.

1856 Baron Paul Dubois, Commander of the Legion of Honour, Member of the Imperial Academy of Medicine, Dean of, and Professor of Clinical Midwifery in, the Faculty of Medicine; Paris.

1835 Carl Johan Ekströmer, M.D., C.M., K.P.S., and W., Physician to the King of Sweden, President of the College of Health, and Director-General of Hospitals; Stockholm.

1841 Christian Gottfried Ehrenberg, Member of the Institute of France; Berlin.

1859 J. Henle, M.D., Professor of Anatomy at Göttingen.

1841 James Jackson, M.D., LL.D., Emeritus Professor of Medicine in the Harvard University, Boston, U.S.

1856 Bernhard Langenbeck, M.D., Professor of Surgery in the University of Berlin.

1843 Baron Justus von Liebig, M.D., Foreign Associate of the Academy of Sciences, Conservator of the Royal Collection, and Professor of Chemistry in the University of Munich.

1841 P. C. A. Louis, M.D., Honorary Physician to the Hôtel-Dieu, Member of the Imperial Academy of Medicine; Paris.

1847 Carlo Matteucci, Professor in the University of Pisa, Member of the Institute of France.

1853 Valentine Mott, M.D., LL.D., Emeritus Professor of Surgery in the University of New York, late President of the New York Academy of Medicine; New York.

1841 Bartolomeo Panizza, M.D.; Pavia.

Elected

1859 Pierre Rayer, M.D., Commander of the Legion of Honour, Member of the Institute, and of the Imperial Academy of Medicine; Paris.

1850 Carl Rokitansky, M.D., Curator of the Imperial Pathological Museum, and Professor at the University of Vienna.

1856 Louis Stromeyer, M.D., Director-General of the Medical Department of the Army of Hanover; Hanover.

1856 A. Velpeau, Member of the Institute, and of the Imperial Academy of Medicine, Professor in the Faculty of Medicine, Surgeon to the "Hôpital de la Charité;" Paris.

1856 Rudolph Virchow, M.D., Professor of Pathological Anatomy in the University of Berlin.

1859 W. Vrolik, M.D., Professor of Natural History at Amsterdam.

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OBSERVATIONS ON THE DISCOVERY OF THE ORIGINAL OBSTETRIC INSTRUMENTS OF THE CHAMBERLENS.

BY

ROBERT LEE, M.D., F.R.S.,
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Received Oct. 17th.—Read Nov. 12th, 1861.

The operation of turning, in cases of arm and placental presentation, the invention of the midwifery forceps, and the induction of premature labour, must be regarded as three of the most important improvements which have hitherto been made in the practice of midwifery, and every circumstance connected with their introduction cannot fail to excite interest with those who study and practice midwifery as one of the great departments of medical science. Before the year 1818, when Mr. Carwardine presented a brief notice to the Medical and Chirurgical Society, with the original obstetric instruments of the Chamberlens, nothing was known with certainty respecting the invention of the forceps.

The first notice of the discovery of the Chamberlens, that I have met with, is contained in the following case, related by Mauriceau:

Observation XXVI.—D'une femme qui mourut avec son enfant dans le ventre, qui, n'en put jamais etre tiré par un Médecin Anglois qui avoit entrepris de l'accoucher.

Le 19 Aout, 1670 (says Mauriceau) j'ai vu une petite

femme, âgée de 38 ans, qui étoit en travail de son premier enfant depuis huit jours, ses eaux s'etant écoulées dès le premier jour qu'elle avoit commencé à se trouver mal, sans presque aucune dilatation de la matrice. Etant restée en cet état jusqu'au quatrième jour, je fus mandé pour en dire mon sentiment à sa sage-femme, à laquelle je conseillai de la faire saigner ; et au cas que la saignée ne produisit pas le bon effet que l'on en pouvoit espérer, de lui faire prendre l'infusion de deux drachmes de sené pour lui provoquer les douleurs qu'elle n'avoit point : ce qui fut fait le jour suivant, et réussit assez bien, ce remède lui ayant excité des douleurs qui dilatèrent la matrice autant qu'il étoit possible. Néanmoins pour tout cela elle ne put jamais accoucher, et son enfant qui venoit la tête devant, mais la face en dessus, resta toujours au même lieu, sans pouvoir avancer au passage, que cette femme, qui étoit très-petite, avoit tellement étroit, et les os qui le forme si serrés et proches l'un de l'autre, et l'os du croupion si recourbé en dedans, qu'il me fut entièrement impossible d'y introduire ma main pour l'accoucher, quoique je l'aye assez petite, lorsque je fus mandé pour lui donner ce secours, trois jours ensuite de la première fois que je l'avois vue : de sorte qu'y ayant tâché inutilement il ne me fut pas possible d'en venir à bout, ne pouvant introduire ma main qu'avec un extrême effort, à cause de l'étroitesse du passage d'entre les os : et l'ayant introduite elle se trouvoit si serrée, qu'il m'étoit impossible d'en remuer seulement les doigts, et de la faire avancer assez pour pouvoir conduire un crochet avec sûreté, afin d'en tirer cet enfant, qui étoit mort depuis près de quatre jours, suivant l'apparence ; ce qu'ayant essayé je déclarai l'impossibilité d'accoucher cette femme à tous les assistans, qui en étant bien persuadés, me prièrent de lui tirer son enfant du ventre par l'opération Césarienne : laquelle je ne voulus pas entreprendre, sçachant bien qu'elle est toujours très certainement mortelle à la mère. Mais aprés que j'eus laissé cette femme en cet état, ne m'étant possible de la secourir, comme j'aurois fait toute autre qui auroit eu une disposition du corps plus naturelle, il survint aussitôt un médecin Anglois,

nommé Chamberlen, qui étoit alors à Paris, et qui de père en fils faisoit une profession ordinaire des accouchemens en Angleterre dans la ville de Londres, où il a acquis depuis ce tems-là le suprême degré de réputation en cet art. Ce médecin voyant cette femme en l'état que je viens de déclarer, et ayant appris que je n'avois pas trouvé aucune possibilité de l'accoucher, témoigna être étonné de ce que je n'en avois pas pû venir á bout, moi, qu'il disoit et assuroit être le plus habile homme de ma profession qui fut à Paris; nonobstant quoi il promit d'abord de l'accoucher très assurément en moins d'un demi-quart d'heure, quelque difficulté qu'il pût y trouver: pour quoi faire, il se mit aussitôt en besogne, et au lieu d'un demi-quart d'heure, il travailla durant plus de trois heures entières, sans discontinuer que pour reprendre haleine. Mais ayant épuisé inutilement toutes ses forces, aussi-bien que toute son industrie, et voyant que la pauvre femme étoit prés d'expirer dans ses mains, il fut contraint d'y renoncer, et d'avouer qu'il n'étoit pas possible d'en venir à bout, comme je l'avois bien déclaré. Cette pauvre femme mourut avec son enfant dans le ventre, vingt-quatre heures après les extrêmes violences qu'il lui avoit faites; et par l'ouverture que je fis de son corps, en lui faisant après sa mort l'operation Césarienne, que je n'avois pas voulu lui faire, comme j'ai dit, durant qu'elle vivoit, je trouvai son enfant et toutes les autres choses disposées comme je les ai specifiées ci-dessus, et la matrice toute déchirée et percée en plusieurs endroits par les instruments dont ce médecin s'étoit servi aveuglément sans la conduite de sa main, laquelle pour être une fois plus grosse que la mienne, il n'avoit vraisemblablement pas pû introduire assez avant pour l'en préserver. Néanmoins ce médecin étoit venu d'Angleterre à Paris depuis six mois, dans l'espérance d'y faire fortune, faisant courir le bruit qu'il avoit un secret tout particulier pour les accouchements de cette nature. Se vantant de faire les plus désespérés et abandonnés en moins d'un demi-quart d'heure: et il avoit même proposé a M. le premier médecin du Roi, que si on vouloit lui faire donner dix mille écus de récom-

pense, il communiqueroit son prétendu secret. Mais la seule expérience de ce facheux accouchement le dégôuta tellement de ce pays-ci, qu'il s'en retourna peu de jours ensuite en Angleterre: voyant bien qu'il y avoit à Paris de plus habiles gens en l'art des accouchemens que lui. Mais avant que de partir pour Londres, il me rendit visite chez moi, pour me faire compliment sur le Livre des Accouchemens que j'avois donné au Public depuis deux ans: et me dit pour lors, qu'il n'avoit jamais trouvé d'opération si difficile à faire, que l'accouchement de cette femme, dont il n'avoit pas pu venir à bout, me louant de ce que je ne l'avois pas voulu entreprendre aussi inconsidérément qu'il avoit fait. Je reçûs son compliment comme je devois, lui faisant entendre qu'il s'étoit bien trompé en croyant trouver autant de facilité à accoucher les femmes à Paris comme il avoit pû trouver à Londres, où il s'en retourna dès le lendemain, emportant avec lui un exemplaire de mon Livre, qu'il fit imprimer après l'avoir traduit en Anglois, en l'année 1672, depuis laquelle traduction il s'est acquis un si haut degré de réputation en l'art des accouchemens dans le ville de Londres, qu'il y a gagné plus de trente mille livres de rente, qu'il posséde présentement, à ce que m'ont dit depuis peu des personnes de sa connoissance. S'il lit quelque jour cette observation lorsque je l'aurai rendu publique et qu'il soit aussi sincére que je le suis, je crois qu'il avouera que je l'ai rapportée avec toute la religion que peut demander une vérité très constante, dont il peut fort bien se souvenir. L'extraordinaire difficulté qui se rencontra en cet accouchement m'a fait inventer un instrument, auquel j'ai donné le nome de tire-tête, par son usage, qui est incomparablement plus commode, et plus sûr que celui des crochets. Si j'avois eu pour lors un pareil instrument, je suis certain qu'avec son aide j'aurois pû sauver la vie à cette femme. J'en ai fait représenter la figure dans mon Livre des accouchemens, où j'ai enseigné très exactement la manière de s'en bien servir.*

* 'Observations sur La Grossesse et l'Accouchement,' &c., par François Mauriceau, &c., tome ii, p. 23, 1738.

I have not succeeded in obtaining a sight of the first edition of Hugh Chamberlen's translation of Mauriceau's work, and I am uncertain if a copy exists in Great Britain. I have long had in my possession a copy of the 7th edition, published in 1736. On the 27th of August last, my learned friend, Dr. Munk, author of the 'Roll of the Royal College of Physicians, London,' shewed me a copy of the second edition, published in 1696, and gave me an opportunity of comparing the second and the seventh edition; from this it appeared that the seventh was a bare reprint of the second, and there is every reason to believe that the second is a reprint of the first, which, according to Mauriceau, appeared in 1672. The preface to the second edition contains the only account of the midwifery forceps ever published by the Chamberlens. When Dr. Hugh Chamberlen, the translator of Mauriceau's works was born or died I have not been able to ascertain. The 'Roll of the Royal College of Physicians' contains no biographical account of this distinguished physician; but there is an interesting life of Dr. Hugh Chamberlen, to whom a magnificent marble monument was erected in Westminster Abbey by the Duke of Buckingham, on which there is a Latin inscription, which was written by Bishop Atterbury. At the time the translation of Mauriceau's work appeared, this eminent practitioner was only eight years of age, and could not therefore have been the individual to whom Mauriceau refers in his narrative of the unfortunate case at Paris, and the translator of his work—as has been stated in the 'Roll of the Royal College of Physicians,' but the son.

The translation of Mauriceau's work into English, soon became the text-book of all who were engaged in the practice of midwifery in this country, and from this time may be dated most of the improvements in it which subsequently took place in the course of the following century.

As midwifery in Great Britain may now be regarded as in a revolutionary state, and as many sound doctrines established by Mauriceau, the Chamberlens, and their successors, appear to be in danger of being for a time sub-

verted, the preface of the translator may now perhaps be read with advantage.

"The Translator to the Reader.

"Courteous Reader,—Having long observed the great want of necessary directions how to govern women with child and in child-bed, and also how new-born babes should be well ordered, I designed a small manual to that purpose; but meeting some time after in France with this treatise of Mauriceau (which, in my opinion, far exceeds all former authors, especially Culpeper, Sharp, Speculum Matricis, Sermon, &c.; being less erroneous, and enriched with divers new observations), I changed my resolution into that of translating him, whom I need not much commend, because he is fortified with the approbation of the wardens of the Chirurgeons' Company of Paris.

"His Anatomy was in the first edition omitted; but is in this, which, with the book, I have carefully rendered into English, for the benefit of our midwives, of whom many may yet admit of an additional knowledge. The principal thing worthy their observation in this book is, accurately to discover what is properly their work, and when it is necessary to send for advice and assistance, that so, many women and children may be preserved that now perish for want of seasonable help. My author makes out the breaking of the right waters for the proper season of a natural delivery; and whenever a child is not born then, or soon after, nature is so much short of performing her office. This is certainly a great truth, and all wrong births should never be longer delayed; and for the most part, floodings and convulsions not so long, lest the woman lose her life before even the water breaks. But if no dangerous accident intervene, in a right labour, one may lengthen out their expectation to twelve hours after; and though some may have been happily delivered twenty-four hours or two days after, yet I should not advise any to run that hazard, provided they can have an expert artist to deliver them without

destroying the child; because many have perished in that case; and it is not prudent to venture where but one of many escapes; for the longer the labour continues after the breaking of the waters, the weaker both woman and child grow, and the drier her body, which renders the birth more difficult; and 'tis ever good taking time by the foretop.

"And that midwife's skill is certainly the greatest, and she deserves most commendation who can soonest discover the success of the labour, and accordingly either wait with patience or timely send for advice and help. Nor can it be so great a discredit to a midwife (let some of them imagine what they please) to have a woman or child saved by a man's assistance, as to suffer either to die under our hand, although delivered; for that midwife mistakes her office that thinks she hath performed it by only laying the woman; because her principal duty is to take care that she and her child be well, with safety and convenient speed, parted: and if this be impossible for her and feasible by another, it will justify her better to waive her imaginary reputation, and to send for any help to save the woman and child, than to let any perish, when possible to be prevented: as in the case of my author's sister, and in the twentieth chapter of the first book. Yet, in countries and places where help and good advice are not seasonably to be had, midwives are compelled to do their best, as God shall enable them: which dangerous and uncertain trials it doth not become them to put in practice upon women, where no timely assistance need be wanting. Most wrong births, with or without pain; all floodings with clods, though little or no pain, whether at full time or not; all convulsions, and many first labours; and some others, though the child be right, if little or no pain after the breaking of the waters, and the child's not following them in some six or ten hours after, require the good advice of, and peradventure, speedy delivery by expert physicians in this practice. For though a few may escape in these cases, yet the far greater number perish, if not aided by them. Let me therefore advise the good women, not so readily to blame their midwives who are not backward, in dangerous

cases, to desire advice, lest it cost them dear by discouraging and forcing them to presume beyond their knowledge or strength, especially when too many are overconfident.

"These few things wherein I dissent from my author, if of dangerous consequence, are noted in the margin: if not, are left to the discretion of the reader.

"I confess he is often too prolix—a fault which the French much affect; however, I chose rather to translate him according to his own style, than contract him; and also to leave unaltered some things not very well expressed, being of small moment; I find also he distinguishes not between the words plaister and ointment, but uses them promiscuously, one for the other.

"In the seventeenth chapter of the second book, my author justifies the fastning hooks in the head of a child, that comes right, and yet because of some difficulty or disproportion cannot pass; which I confess has been and is yet the practice of the most expert Artists in midwifery, not only in England, but throughout Europe, and has much caused the report, that where a Man comes, one or both must necessarily die; and is the Reason of forbearing to send, till the child is dead or the mother dying. But I can neither approve of that practice nor those delays; because my father, brothers, and myself (tho' none else in Europe as I know,) have, by God's blessing and our industry, attained to, and long practised a way to deliver women in this case without any prejudice to them or their infants, though all others (being obliged, for want of such an expedient, to use the common way) do, and must endanger, if not destroy, one or both with hooks. By this manual operation a labour may be dispatched (on the least difficulty) with fewer pains, and sooner to the great advantage and without danger, both of woman and child. If, therefore, the use of hooks by physicians and chirurgeons be condemned (without thereto necessitated through some monstrous birth), we can much less approve of a midwife's using them, as some here in England boast

they do, which vast presumption in France would call them in question for their lives.

"In the fifteenth chapter of this book, my author proposes the conveying sharp instruments into the womb, to extract a head, which is a dangerous operation, and may be much better done by our forementioned art, as also the inconvenience and hazard of a child dying thereby prevented, which he supposes in the twenty-seventh chapter of this second book.

"I will now take leave to offer an apology for not publishing the secret I mention we have, to extract children without hooks where other artists use them, viz., there being my father and two brothers living that practise this art, I cannot esteem it my own to dispose of, nor publish it without injury to them, and think I have not been unserviceable to my own country, although I do but inform them that the forementioned three persons of our family and myself can serve them in these extremities with greater safety than others.

"I design not this work to encourage any to practise by it who were not bred up to it, for it would hardly make a midwife, though it may easily mend a bad one. Notwithstanding, I recommend it to the perusal of all such women as are careful of their own and their friends' safeties, there being many things in it worth their noting. And designing it chiefly for the female sex, I have not troubled myself to oppose or comment upon any physical or philosophical position my author proposes. I hope no good midwives will blame me or my author for reprehending the fault of bad ones, who are only aimed at and admonished in this work; and I am confident none but the guilty will be concerned, and take it to themselves, which I desire they may, and amend.

"Farewell,

"Hugh Chamberlen.

"From my House in Essex Buildings."

In this preface the author alludes to a secret method of extracting the child.

The secret which is here referred to was the Chamberlen midwifery forceps, but until the year 1818 no one knew with certainty what the invention was. It has been stated in several of the historical accounts published of the forceps, that about seventeen years after the occurrence of the case at Paris, related by Mauriceau, Dr. Hugh Chamberlen was compelled to take refuge in Holland, in consequence of espousing the cause of James II. While in Holland it is asserted that he sold the lever to Roonhuysen as the secret which he possessed; but there is no direct evidence to prove that he parted with the forceps. The vectis was afterwards sold, it is stated, to two Dutch accoucheurs, Reehelman and Ruysch. Chapman asserted in 1734, and Gebbard in 1735, that the forceps was Chamberlen's secret, and they gave representations of the instrument. The forceps of Smellie and Denman did not differ essentially from that of Chamberlen, brought to light in the following extraordinary manner, as related by Mr. Carwardine in the ninth volume of the 'Med.-Chir. Trans.'

"*Brief Notice presented to the Medico-Chirurgical Society, with the original obstetric instrument of the Chamberlens.* By H. H. CARWARDINE, Esq.*

"In depositing the obstetric instruments of the Chamberlens among the Archives of the Medico-Chirurgical Society, I beg to offer a few facts and observations, which may serve to authenticate their genuineness and their originality.

"The Estate of Woodham Mortimer Hall, near Maldon in Essex, was purchased by Dr. Peter Chamberlen some time previous to 1683, and continued in his family till about 1715, when it was sold by Hope Chamberlen to Mr. William Alexander, wine merchant, who bequeathed it to the Wine Coopers' Company. The principal entrance to the mansion is through a porch, the masonry of which being carried

[1] 'Medico-Chirurgical Transactions,' vol. ix, p. 1855. Lond., 1818.

up with the building, serves as closets to its respective stories. Two or three years ago, a lady with whom I am intimately acquainted (and from whom I had the particulars) discovered in the floor of the upper closet a hinge, and tracing the line she saw another, which led to the obvious conclusion of a door; this door she soon found means to open. There was a considerable space between the floor and the ceiling below, and this vacancy contained divers empty boxes &c. Among these was a curious chest or cabinet, in which was deposited a collection of old coins, trinkets, gloves, fans, spectacles, &c., with many letters from Dr. Chamberlen to different members of his family, and also the obstetric instruments. Being on terms of intimacy with the family resident at Woodham Mortimer Hall, these instruments have been presented to me, and I have now the gratification of depositing them with your society for the gratification of public curiosity, and to secure to Chamberlen the meed of posthumous fame due to him for his most useful discovery.

"With respect to these instruments, I would briefly observe, that they appear to contain *within themselves* the most direct and conclusive evidence of originality of invention; and that even the progress of this invention may be distinctly traced in its different stages as it passed through the mind of the inventor. First, we have a simple vectis, with an open fenestrum (supposed to be of much more recent invention); then we have the idea of *uniting two* of these instruments by a joint, which makes each blade serve as a fulcrum to the other, instead of making a fulcrum of the soft parts of the mother; and which also unites a power of drawing the head forward. This idea is at first accomplished by a pivot, which being rivcted, makes the instrument totally incapable of application. Then he goes to work again, and having made a hitch in each vectis for the joint, he fixes a pivot in *one only*, which projecting, is to be received into a corresponding hole in the other blade, after they have been applied *separately*. It may be observed, that although there is a worm to the projecting part of the pivot, yet there is no corresponding female screw in the hole

which is to receive it. Every practical accoucheur will know that it is not easy, or always possible, to lock the joint of the forceps with such accuracy as to bring this pivot and hole into apposite contact. This Chamberlen soon discovered, and next produced a light and more manageable instrument, which, instead of uniting by a pivot, he passed a tape through the two holes and winds it round the joint, which method combines sufficient accuracy of contact, security, and mobility.

"From the roughness of the workmanship, I am led to conclude that Chamberlen was his own artificer—a practice, I am told, not uncommon in those days, when mystery and empiricism were not regarded as contemptible, even among the enlightened professors of science.

"H. H. Carwardine.

"London; February 6th, 1818."

In the month of July, 1861, I resolved to visit Woodham Mortimer Hall, but before doing so wrote to Dr. May, of Maldon, requesting that he would have the kindness to communicate to me any information which he had obtained respecting Dr. Chamberlen, and the estate which he had purchased in Essex.

Dr. May kindly complied with my request by sending the following interesting letter, which proves the important fact that the concealment of the instruments took place subsequent to the year 1683, when Dr. Peter Chamberlen died.

"Maldon; July 6th, 1861."

"Dear Sir,—The following account of the discovery of Dr. Chamberlen's instruments in June, 1813, I have received from Mrs. Codd, now a resident in Maldon, who was at the date mentioned and for several years previous, resident at Woodham Mortimer Hall, her husband being the occupant of the place.

"Mrs. Kemball, the mother of Mrs. Codd, being on a visit to her daughter in the year mentioned, happened to go into a closet above the entrance porch. She was struck with

the appearance of a cork or a small disc of wood—Mrs. Codd forgets which—in the floor; a second one was then noticed on a level with the boards. On investigation these were found to cover each a screw head. On pursuing the enquiry, a trap door with small sunken hinges was noticed; on elevating this a cavity between the floor and the ceiling was brought to view. This contained some boxes in which were two or three pairs of the midwifery forceps, several coins, a medallion of Charles I or II; a miniature of the Doctor, damaged by time; a tooth wrapped in paper, written on 'My husband's last tooth;' some little antique plate; a pair of ladies' long yellow kid gloves, in excellent preservation; a small Testament, date 1645. These three latter articles I have seen in Mrs. Codd's possession.

"The space under the floor is about $5\frac{1}{2}$ feet square, and about twelve inches in depth. There are two pieces of iron projecting from under the boards, with holes in them for the reception of the screws in the trap. This remains now in the same condition as it was when discovered forty-eight years ago. The concealment was evidently made subsequent to the death of Dr. Chamberlen, which occurred in 1683, as the Testament above alluded to bears a manuscript date of 1695. The instruments were taken possession of by Mr. Carwardine, a friend of the family, then a practising surgeon now retired, and residing at Earls Colne Priory, in this county. That gentleman took them to London, and presented some of them either to the Medical and Chirurgical Society, or one of the hospitals. When I was a student at the University of Edinburgh, Dr. Hamilton used to exhibit to his class a pair of what he stated to be the original Chamberlen forceps.

"Dr. F. Ramsbotham, in his work on 'Obstetric Medicine and Surgery,' has given an account of the Chamberlen family, and of the discovery of the instruments. In one or two particulars, however, he is incorrect. I send you a literal copy of the inscription and epitaph. The tomb is in tolerable preservation, but some of the lettering is now difficult to decipher. I don't know that a visit to the spot

would furnish much more information; but should you feel disposed to make a pilgrimage to the shrine, I shall be most happy to introduce you.

"Yours very truly,
"GEORGE P. MAY."

Inscription on Dr. Peter Chamberlen's Tomb, in Woodham Mortimer Churchyard.

"Here lyes y^e^ body of Doctor Peter Chamberlen, who was born on the 8th of May, 1601, and dyed on the 22nd of December, 1683, being aged 82 years 7 months and 14 days. He had 2 wives, and by y^e^ first, Jane Middleton, had 11 sons and 2 daughters, and amongst them 45 grandchildren and 8 great-grandchildren, whereof were living at his death 3 sons, viz., Hugh, Paul, and John, and his 2 daughters and 20 grandchildren, and 6 great-grandchildren. By y^e^ second, Ann Harrison, had 3 sons and 2 daughters, whereof only Hope was living at his death, who hath erected this monument in memory of his father. The said Peter Chamberlen took y^e^ degree of Doctor in Physick in severall Universities, both at home and abroad and lived such above three score years, being Physician in ordinary to three Kings and Queens of England, viz., King James and Queen Anne, King Charles y^e^ First and Queen Mary, King Charles y^e^ Second and Queen Katherine, and also to some foreign Princes, having travelled to most parts of Europe, and speaking most of the languages. As for his religion was a Christian, Keeping y^e^ Commandments of God and faith of Jesus, being baptized about y^e^ year 1648, and Keeping y^e^ 7th day for y^e^ Sabbath about 32 years.

"To tell his learning and his life to men
Enough is said, by here lyes Chamberlen;
Death my last sleep, to ease my careful head,
The grave my hardest, but my easiest bed;
The end of sorrow—labour and of care,
The end of trouble, sickness, and of feare.
Here I shall sin no more—no more shall weep,
Here's surely to be found a quiet sleep;
Death's but one night, my life hath many seene
My life brought death—death brings me life againe
Seeds rise to trees—hearbes rise again from seed,
Shall bodies then of men obtain worse speed?
We dayly dye entomb'd in sleep and night,
But in the morning we renue our light;

Hence spring my joyes and comfortes evermore
I cannot feele but what Christ felt before.
Wee now believe, and heare, and talk by guess,
Then I shall see, and what I see possess;
And when I wake wrapt in Eternal light,
Of God and Christ, I know no more of night;
Crown'd with eternal glories ever blest,
Oh! happy rest that brings me all the rest.
Bodies calcin'd to iemms like stars shall sing,
Ravish'd with joyes and praises of my king,
Praised be God my Saviour, Praise his name
Angels and Saintes sing with me his fame.

"These verses were found, made, written and ordered by Doctor Peter Chamberlen, here interred, for his Epitaph."

On the 12th of August 1861, I made a pilgrimage to the tomb of Dr. Peter Chamberlen along with Dr. May, and we carefully examined the closet in which the instruments had been so long concealed. It was empty, but the description of it given by Dr. May I found in every particular most correct.

The tomb is in a dilapidated state, and the inscription will soon be illegible if not renovated. I wrote to the court of the Coopers' Company, to whom the estate now belongs, entreating them to prevent the entire destruction, by time and the influence of the atmosphere, of the monument placed over the grave of one of the most illustrious individuals this country has ever produced; but the worshipful Company declined employing their funds for such a purpose.

At my visit to Maldon I was introduced to Mrs. Codd, and saw the New Testament and the yellow gloves referred to in Dr. May's letter.

"West House, Maldon; Aug. 19th, 1861.

"Dear Dr. Lee,—I copy from the title page of the Testament, the following:

"'Imprinted at London by Ronert Barker,
Printer to the King's Most Excellent Majestie,
and by the
Assignees of John Ball (or Bell) 1640.'

"On the fly-leaf is a heading, as below :

"'1695, June ☉ 9'

"This is followed by two or three lines of manuscript (evidently bad writing) which I cannot decipher.

"Mrs. Codd is quite positive as to the Testament being found with the other relics, which proves beyond doubt that they were not placed there by the doctor's hand, at any rate some one had access to them afterwards.

"If I can be of service to you in any way in this matter, I shall feel pleasure in rendering such assistance.

"Believe me,
"Yours faithfully,
"George P. May."

Inscription on the Monument in Westminster Abbey to Dr. Hugh Chamberlen (not the translator of Mauriceau.)

"HUGO CHAMBERLEN,
Hugonis ac Petri utriusque Medici
Filius ac Nepos :
Medicinam ipse feliciter excoluit et egregiè honestavit,
ad summam quippe Artis suæ peritiam,
summam etiam in dictis et factis fidem,
insignem mentis candorem,
morumque suavitatem adjunxit ;
ut, an languentibus, an sanis acceptior esset,
an medicus, an vir melior,
certatum sit inter eos,
qui in utroque laudis genere primarium fuisse
uno ore consentiunt.
Nullam Ille medendi rationem non assecutus,
depellendis tamen puerperarum periculis,
et avertendis infantium morbis,
operam præcipuè impendit ;
câque multoties cavit,
Ne illustribus familiis eriperentur haeredes unici,
ne patriæ charissimæ cives egregii :
universis certe prodesse quantum potuit, voluit.

adeòque distractâ in partes Republicâ
cum iis a quorum sententia discessit
amicitiam nihilominus sanctè coluit,
artisquè suæ præsidia lubens communicavit.
Fuit Ille
tantâ vitæ elegantiâ ac nitore,
animo tam forti tamque excelso,
indole tam propensa ad munificentiam,
specie ipsâ tam ingenuâ atque liberali,
ut facile crederes
prosapiæ ejus nobilem aliquem extitisse auctorem,
utcunque ex præclarâ stirpe veterum Comitum de Tankerville
jam a quadragentis Illum annis ortum nescires.
In diversâ quam expertus est Fortunæ sorte,
quod suum erat quod decuit semper tenuit:
cum magnis vivens haud demissè se gessit,
cum minimis non asperè, non inhumanè;
utrosque eodem bene merendi studio complexus,
utrisque idem æquè utilis ac charus.
Filius erat mirâ in Patrem pietate,
pater filiarum amantissimus quas quidem tres habuit,
unam è prima conjuge,
duas ex alterâ, castas, bonas, matrum similliimas;
cum iis omnibus usque ad mortem conjunctissimè vixit:
tertiam uxorem sibi superstitem reliquit.
Ad humaniores illas ac domesticas virtutes tanquam cumulus accessit,
rerum Divinarum amor non fictus,
summa Numinis ipsius reverentia;
quibus imbuta mens exuvias jam corporis depositura,
ad superiora se erexit,
Morbi diutini languioribus infracta permansit:
et vitam tandem minimè vitalem,
non dissolutè non infructuosè actam,
morte verè Christianâ claudens,
ad patriam cœlestem migravit; obiit 17 Junii A.D. 1728:
annis sexaginta quatuor expletis;
provectiori ætate sane dignus,
cujus ope effectum est,
ut multi non inter primos penè vagitus extincti
ad extremam senectutem possit pervenire.
Viro integerrimo, amicissimo,
obs servatam in partu vitam,
ob restitutam sæpius et confirmatam tandem valetudinem,

Monumentum hoc Sepulchrale
eujs efficie insignitum posuit
Edmundus Dux Buckinghamiensis,
appositis hic inde statuis
ad exemplum marmoris antiqui expressis,
quæ et quid ab ille præstitum sit
et quid Illi redditum licet
adhuc debetur posteris testatum faciant.

John Sheffield, Duke of Buckingham,
died in 1720.

This Dr Hugh Chamberlen was physician to Charles II. He was admitted a fellow of the Royal Society on November 2nd, 1681.

APPENDIX TO DR. LEE'S PAPER,

CONTAINING

LETTERS FROM DR. MUNK, DR. MAY, AND MR. CARWARDINE,

RELATIVE TO

DR. PETER CHAMBERLEN AND HIS FAMILY.

"Finsbury Place; July 4th, 1861.

"My dear Dr. Lee,—I am painfully conscious of the incomplete and very unsatisfactory character of the information which I have been able to put together concerning the Chamberlens. To unravel the obscurity, and I believe it may be done, would require much search and involve a long essay, for neither of which could I find time until the 'Roll' is completed. Then, if no one else takes up the subject, I will see what can be done, but I really wish you would yourself undertake it, and any assistance I could give, you may command.

"I see the way how the matter is to be elucidated, and when I have the pleasure of seeing you will expound to you my views. There is much in the annals of the college about Peter Chamberlen, M.D., and his father. The latter practised as a surgeon-apothecary in the city, and, as far as I can make out, had no mean reputation as an accoucheur. To me it seems clear that Hugh Chamberlen, M.D. ('Roll,' vol. i, p. 359), did practise midwifery, if only from the following passage in the inscription on his monument (p. 461.)

"'Nullam Ille medendi rationem non assecutus, depellendis tamen *puerperarum periculis* et avertendis infantium morbis operam præcipuè impendit; eâque multoties cavit, ne illustribus familiis eriperentur hæredes unici, ne patriæ charissimæ cives egregii.'

"The whole matter is full of interest; it ought to be

cleared up, and none so proper to undertake it as yourself. Pray do so, and make any use you can of

"Yours always truly,

"W. Munk.

"Dr. R. Lee."

"Finsbury Place; July 20th, 1861.

"My dear Doctor,—I have only time to thank you for the copy of the inscription, which I will soon return.

"I think I see my way more clearly. Hugh Chamberlen, the son of Peter, and the father of Hugh, whose monument is in Westminster Abbey, must have been the translator of Mauriceau. If this turns out to be the case, and I have little doubt upon the matter, you will find that Peter, of Woodham Mortimer, was the inventor of the forceps.

"Yours always truly

"W. Munk.

"Dr. Lee."

"My dear Dr. Lee,—Your note of the 22nd has been forwarded to me from the college, and you have, I presume, in the interval received one from me, in which I show that there were two Hugh Chamberlens, both physicians. The elder of the two was undoubtedly the translator of Mauriceau. He was the son of Peter Chamberlen, M.D., who died and is buried at Woodham Mortimer, and is the Hugh mentioned in Peter's inscription as one of his three surviving sons. He was not a member of the College of Physicians. The second Hugh is the one mentioned in 'The Roll,' vol. i, p. 459. He was the son of Hugh, the translator of Mauriceau, and the grandson of Peter, of Woodham Mortimer, or, in the words of the inscription in Westminster Abbey, 'Hugonis ac Petri utriusque medici, filius ac nepos.'

"The second edition of the translation of Mauriceau, by Hugh Chamberlen, is now before me; it was published in 1696, and seems to me to be a mere reprint of the first. The translator's address to the reader, which is the all-important part, is certainly reprinted without alteration from the first. The first edition was published, I believe, but am

not sure, as you say, in 1672; when Peter Chamberlen, the translator's father, was still living; hence his apology for maintaining the secret of the forceps, that it was possessed by his father and two brothers then living. The father, Peter Chamberlen, died in 1683, yet the same statement occurs in the second edition, anno 1696, as, I suspect, you will find also in your edition of 1736.

"The conviction on my mind grows stronger the more I go into the question, that Peter Chamberlen was the inventor of the forceps, and that he communicated it to his three sons who survived him, all of whom, it is clear, practised midwifery ('my two brothers and myself,' writes Hugh, in his address to the reader), viz., Hugh, the eldest, the translator of Mauriceau, Paul, who is known to have done so, and John, of whose history or career but little, I suspect, is now to be recovered.

"I wish you well through your dissections. I hope soon to avail myself of your kind offer to see with my own eyes this additional instance of the immense importance of visceral nerves.

"Yours always most truly,

"W. Munk.

"Finsbury Place; July 24th, 1861."

"Finsbury Place; August 17th, 1861.

"My dear Sir,—I congratulate you on your visit to Woodham Mortimer—in other words, your pilgrimage to the shrine of the great Peter Chamberlen, for great he was, if, as I get more and more convinced, *he* was the inventor of the forceps. I shall look to see all the mysteries cleared up in your intended paper, but depend upon it that no view will bear examination but that which assigns the discovery or invention to Peter.

"I wrote, telling you of my having seen the second edition of the English Mauriceau. I have not had the good fortune to find the first.

"Yours always truly,

"W. Munk.

"Dr. Robert Lee."

"Colne Priory; September 7th, 1861.

"Dear Sir,—Absence from home must apologise for not having sooner acknowledged your kind attention in sending me a copy of the engravings from your elaborate and, I doubt not, very accurate dissections of the nerves supplying the heart and uterus, a valuable addition to our knowledge on that subject, which, I trust, will be justly appreciated by teachers and students. I have now withdrawn from practice some years, being in my eighty-third year, and so nearly blind that it is with much difficulty and uncertainty that I write a few lines, and must trust to your indulgence to correct or excuse blunders.

"With respect to Chamberlen and his obstetric instruments, I wish it were in my power to answer your inquiries in a more satisfactory manner; I did not know of the discovery till some time after it had been made. From my friend then residing at Woodham Mortimer Hall I begged the instruments, for the purpose of depositing them in some museum, where they might be open to the inspection of professional men, &c., and wrote a brief memoir of the discovery, published in the 'Medico-Chirurgical Transactions,' on presenting them to that society (by a misprint my name is there given as *Cansardine*). I heard something about the MS. petition to Parliament which you allude to, but never saw it; from what I heard Dr. Gooch say in his lectures, some such document must once have been in his hands. What became of it after I know not.

"The lady you mention as having been at Maldon must have been Mrs. Codd, widow of our late coroner for the county (then residing at Woodham Mortimer Hall), and daughter of my old friend, Mrs. Kemball, who discovered the secret recess where these curiosities were deposited, so that you were on the right track for the most accurate information. Were I enabled to supply you with anything more to the purpose, it should be at your service from

"Dear sir, yours very truly,

"H. H. Carwardine."

"Finsbury Place; September 16th, 1861.

"My dear Dr. Lee,—I have just found out that the *great* Peter Chamberlen received his preparatory education at Merchant Taylors' School, and there is extant an engraved portrait of Paul Chamberlen, R. White del., S. Trotter sc., from an original drawing, said to have been taken in 1655.

"Little by little we shall get together some particulars of the personal history of the various members of this really distinguished family. It is an amusement to my *hore subsecivæ* to ferret out these little incidents. I only hope I do not *bore* you.

"You have, I hope, got your copy of my second volume.

"Yours always truly,

"W. Munk.

"Dr. Lee."

"West House, Maldon; September 27th, 1861.

"Dear Dr. Lee,—I return the MS. you kindly lent me, with many thanks for the opportunity of perusing it. It contains much matter of special interest, and does much in supplying the deficient links in the great Chamberlen chain. With yourself, I doubt, however, if the publication would excite a general interest. I notice the flattering compliment you designed for me in the matter of the dedication, but in the event of publication I should have urged the selection of a name which would have a higher claim for emblazonment in fame's annals than the humble one I bear.

"In the MS. you have the following note:—'This Dr. Hugh Chamberlen was physician to Charles II.' This must be an anachronism. The Hugh here referred to is Hugh, *nepos*, translator of Mauriceau. Charles II. died 1685, when this Hugh was but twenty, or, at most, twenty-one years old; and he did not graduate until four years after this. Peter, the grandfather, was physician to Charles II (*vide* epitaph).

"We have no photographers here, except one or two of very moderate abilities, so I have taken over to the Hall Mr. Nightingale, an artist of good reputation in his profession, to inspect the tomb and mansion. You will recollect that they cannot both be included in the same sketch. He will execute two small paintings in oils for £5. He says that for this sum he cannot undertake to do very elaborate specimens, but he guarantees they shall be fit to hang up in any apartment. I possess some of his works, and have faith in his statement."

"Believe me, dear doctor,

"Yours very truly,

"GEO. P. MAY.

"Dr. Lee."

NOTE.—Dr. Lee's paper was accompanied by two well-executed oil paintings representing Woodham Mortimer Hall and the Tomb. (*Sec.*)

ON CERTAIN GRAVE EVILS

ATTENDING

TENOTOMY,

AND

ON A NEW METHOD OF CURING DEFORMITIES OF THE FOOT.

BY

RICHARD BARWELL, F.R.C.S.E.,

ASSISTANT-SURGEON TO THE CHARING CROSS HOSPITAL.

Received Oct. 29th.—Read Nov. 26th, 1861.

Before the year 1832, when Stromeyer realised the safety of subcutaneous division of tendons and muscles, the treatment of all deformities of the foot was simply mechanical; the individual exceptions being too few to influence this statement. But since the almost total absence of injurious inflammations in subcutaneous wounds has been clearly and practically established, tenotomy has been the one great resource in all such cases. The rapid effects of these operations must always give them a certain brilliancy and attraction, yet, in my opinion, they frequently produce lameness, less apparent, perhaps, but certainly more inrable, than the original disease.

In the purely mechanical treatment of distorted foot from excessive muscular contraction, which the use of the tenotome has superseded, it was found that the mere *lateral* twist could be overcome without any great difficulty, while the most obstinate distortion was the exaggerated extension of the part. The *pes equinus* could hardly ever be cured; *equino-varus* was, *cæteris paribus*, obstinate in a direct

proportion to the amount of the extension. That is to say, the difficulty of overcoming a contracted muscle is, other things being equal, in a direct ratio with its size and strength.

At the present time the treatment of pes equinus is, above all others, simple in its performance, and happy in its results. The restoration of all those other deformities in which extension mingles is also greatly assisted by annihilating that overaction of the gastrocnemius, to which much of the inward twist of the foot in equino-varus is attributable. But this last-named deformity is now treated by division of four tendons, at least—the tibialis posticus, the flexor longus digitorum, the tibialis anticus, and the tendo Achillis, and frequently also of the plantar fascia. A very similar treatment is inflicted on valgus. "The peronei tendons are to be divided, or together with them those of the extensor longus digitorum and the tendo Achillis, and also those of the tibialis anticus and extensor proprius pollicis." Can we be surprised that after this "there is difficulty in continuing efficient support to the arch of the foot; and even after the arch has been restored support is required during many months?"

But, besides the cases which arise from excessive action in one set of muscles, there are others which have their origin in partial or total paralysis or in debility of certain other muscles. If, in such instances, it be endeavoured to restore the balance of the limb by dividing the tendons of the still active muscles, the consequences are very disastrous; but even orthopædists do not often now, I believe, tenotomize such cases, although no more efficient apparatus than the old jointed iron and Scarpa's shoe appears to be employed in that special practice.

Now, the difficulty of overcoming a contracted muscle being, as I have already remarked, in exact proportion to its strength, it follows that it is most difficult, or, indeed, all but impossible, to overcome the sural muscles, those attached to the tendo Achillis. Hence division of that tendon is a most valuable, an all but indispensable, resource in all deformities of the equinal or extended varieties; and it happens

that the tendon is so situated and surrounded, that not only is its division, but also its reunion, extremely easy. So remarkably is this the case, that it requires a diligent application of ignorant management to produce a non-union of this tendon. But are the other tendons, whose section is so constantly performed, thus easily reunited? This question occurred to me rather more than four years ago, when I was struck by observing on a patient, who had long before been freely tenotomized *secundum artem*, that several movements of his foot were very feeble and uncertain. Since then it has fallen to my lot to see several feet in the same circumstances, both as to apparent cause and effect, but the full solution of the question only presented itself about a year ago.

There are four experiments on dogs performed by M. Bouvier, and reported by him in the 'Bulletin de l'Académie Royale' (t. viii, pp. 115-17), in the year 1842. He divided subcutaneously the flexor carpi ulnaris and radialis, the flexor digitorum sublimis and profundus; in one case all of them, generally two or three only. In no one instance did the subcutaneous wound reunite so as to restore the use of the parts. In one experiment the two divided tendons did not unite at all. In another, all the severed ones were massed together, thus destroying their normal action; and in two instances, besides this latter condition, the new tissues bound the tendons firmly to the bone, so as utterly to annihilate all muscular action. This last event was found also in an experiment by M. Bouley. Thus we have five experiments of division of some tendon other than the tendo Achillis, with the result in every case of destroying the action of the muscle.

It may easily be averred that experiments on animals cannot be relied on as proof of what happens in man. Post-mortem examinations after tenotomy, moreover, are not common; but Mr. William Adams has been able to gather together, in his book on the 'Reparative Process in Human Tendon,' the results of thirteen autopsies. In this number there are six in which the tendo Achillis only was divided, a tendon which should never do badly. There are, therefore, seven cases, in which other tendons were also divided; and

in every one of them one or more of the severed tendons is either not united at all or is adherent to the bone or surrounding parts, so as to abolish the action of the muscle. In no one instance, in which the tibialis posticus and flexor longus digitorum, one or both, were divided, did they so unite as to be of the slightest use, while the tibialis anticus is more exposed to extinction by non-union than by false union. Now, these are the only accounts of examination in the human body of the actual effects of tenotomy upon tendons other than the tendo Achillis. The results are confirmed by experiment. What conclusion is to be drawn from them but that such muscles as the tibialis posticus, flexor longus digitorum, and probably also the peronei (which are similarly placed behind the leg-bones), might as well be struck with sudden and irremediable paralysis as be subjected to the knife of the tenotomist; and that, moreover, other tendons—those in front of the foot—are only a little better off in this particular? Under such circumstances the phrase made use of at the commencement of this paper—that tenotomy frequently produces lameness, less apparent, perhaps, but certainly more incurable, than the original disease—is, I hold, fully justified.

Analysis of Mr. Adams' seven cases of Autopsy in which, during life, tendons other than the tendo Achillis had been divided. (*The cases are numbered in accordance with the original.*)

No. of Case		Tendons divided.	Results observed.
I.		Tendo Achillis Tibialis anticus	Non-union of tibialis anticus.
II.	Left	Tendo Achillis Tibialis posticus Tibialis anticus Flexor longus digitorum	Non-union of tibialis posticus. Non-union of flexor longus digitorum.
	Right	Tendo Achillis Tibialis anticus	The tibialis posticus was supposed to be, although it was not, divided.
III.		Tibialis anticus Tibialis posticus	Union of posterior tibial to the bone.

No. of Case.	Tendons divided.	Results observed.
IV.	Tibialis posticus Flexor longus digitorum	Union to adjacent parts. No union; held together by shreds of sheath to which also other tendon adhered.
V.	Tendo Achillis Tibialis anticus Tibialis posticus Flexor longus digitorum	Tibialis posticus and flexor longus digitorum adhered together and to the bone.
VI.	Tendo Achillis Tibialis anticus Tibialis posticus Flexor longus digitorum	Tibialis and posticus and flexor longus digitorum adhered together and to the bone. Ends of tibialis anticus hung together by shreds of sheath.

In the five next cases the tendo Achillis only was divided.

XII.	Tendo Achillis Tibialis posticus Flexor longus digitorum	Non-union of tibialis posticus. No retraction of flexor longus digitorum.

After this scrutiny into the effects of tenotomy we come to another inquiry. Cannot most cases, in fact, nearly every case, of talipes, be reduced without division of the tendons in question? Dr. Little, in some papers on "Unnecessary Orthopædic Operations" ('Lancet,' 1857), after saying that "in London indiscriminate operation is the rule," gives certain signs whereby the necessity or non-necessity of operation may be ascertained; but he speaks of tenotomy generally, including the tendo Achillis. If, however, we grant the propriety of dividing this tendon, the signs which might justify further operation must be, after what we have just seen, excessively severe. Let me, for instance, again refer to Mr. Adams's book, to Case 3 on his list. In the right foot of that unfortunate patient an attempt had been made to divide the posterior tibial tendon, and my friend Mr. Adams says—"Now, as this tendon was supposed to have been divided, and the case had proceeded as favorably as if it had been divided, it would," &c. "But the view I am disposed to take is, that the tendon never was divided."

Now, Mr. Adams filled for many years, with credit to himself and advantage to the school, the post of demonstrator of morbid anatomy at St. Thomas's Hospital, and probably knows as well as any man the appearance of a divided tendon. But what an extraordinary fact does that sentence disclose! We have only six cases of post-mortem examination after section or supposed section of the posterior tibial tendon, and in one of these instances the tendon was *not* divided; yet the deformity was reduced with such ease that the orthopædist supposed it had been cut. Now surely we may question how many of the cases in which the tendon was really divided would have done as well without such severance. Would a sixth have done as well—or a half—or would five sixths have "proceeded as favorably," with the additional advantage of retaining some use in the muscle?

We may not have quite sufficient data at present to determine the exact proportion, but at all events we have sufficient to show that, under the circumstances which I have endeavoured to portray, the tendons in question should never be divided, except in the very rare cases in which *no other* means will succeed in reducing the deformity. Therefore we must return to mechanical treatment for the elongation of those muscles whose size renders this possible, and which have tendons so placed as to cause their section to be destructive of muscular action.

All the best forms of instrument hitherto invented act on the principle of confining the foot in a shoe or *sabot*, which, by springs of various shapes and materials, bend or twist the limb in a direction contrary to that of the deformity. There are several grave objections to the application of force through the medium of a shoe—the impediment thrown in the way of walking, the pressure on the limb, &c. But the greatest inherent and insurmountable defect is that the antagonistic force is not applied in the delicate and discriminative manner employed by nature; the foot is treated as a clumsy whole, to be twisted inward or outward upon a stiff turnboard, to which it is bound

for the purpose. Let me explain this a little more fully. The foot consists of twelve bones (leaving out the toes), to every one of which muscles are connected. Even when not attached, these muscles or their tendons glide through grooves or over surfaces of the bones, and strongly influence their position and movement. The balance of the different parts of the foot is kept up by the equalised antagonism of the muscles. Deformity is produced by the predominance of one set, whether it arise from excess of power in the prevalent muscles or deficiency in their opposers. Let us take as an example the fibular group, and consider how the long peroneus crossing the foot almost transversely at the base of the metatarsal bones not only keeps the outer side properly raised, but also draws the front half of the foot outwards; in this latter action it is greatly assisted by the peroneus brevis, the two together antagonising by peculiarity of position the more powerful anterior and posterior tibial muscles, whose action is to drag the inside of the foot upward, and to bend its anterior half inwards upon the posterior. Now, when these fibular muscles are deficient, the loss of their beautifully adapted action allows the production of varus; when they overmaster the others, valgus and flat foot are established. The shoe is clumsily designed to replace the subtle interaction of these muscles by fixing the limb in a rigid case, and twisting it inward or outward, dealing with it as a single whole, and not as a construction of many well-fitting parts.

In fact, however, when any of these constituents change their position, and thus the whole foot its form, the only rational indication is to use some means of supplying the overbalanced muscular power *in its proper place and direction*, until the organs themselves regain their due force; and this latter can only take place when *the foot is allowed its liberty*. I believe myself to have fulfilled these indications by the following method, which, though simple in itself, is difficult to describe. The only necessary apparatus is strapping-plaister;[1] a piece of tinned iron about an inch

[1] Emplastrum resinæ, spread on stout twilled calico.

broad, as long as the patient's leg, and provided at its upper end with a wire loop; a few india-rubber springs of $\frac{1}{4}$-inch cord of various lengths, and furnished at each end with a steel hook; and some eyelets, with the pincers for fixing them.

First, a piece of the plaister is cut into a trapezoid form, in such wise that its broadest part, adherent to the sole and side of the foot, shall follow with considerable accuracy the course and insertion of the weakened tendon. The narrower part shall lie on the side of the foot, a little before or behind one or other of the malleoli, as the case may be: it is not to adhere, but to be folded on itself with the sticky sides together, and through the double thickness an eyelet must be inserted. The foot must now be held by an assistant as nearly as possible in the normal position, and be evenly strapped from the toes backward, leaving out the ends into which the eyelets are driven. By these first-named pieces of strapping the insertion of the muscle or muscles is represented. (See Plate I, fig. 1.)

We now turn to the *leg*. A piece of strapping rather broader than the tin, and three times as long, is made to adhere over the defective muscle, from its origin to just above the ankle-joint, the superabundant length hanging loose below. Over the plaister which covers the muscle is placed the piece of tin, roughly moulded to fit the surface, and padded at its lower end with a little cotton-wool. The additional length of strapping is next turned upward over the tin. The leg is then to be smoothly strapped, in continuation with the circular strapping on the foot, from the ankle to just beyond the upper end of the tin, care being taken to leave the wire-loop uncovered. There is still an additional length of longitudinal plaister, which, for security, may be brought down and made to adhere outside the circular pieces. Now it will have been perceived that the arrangement of the longitudinal piece of strapping is as follows: it first adheres to the skin of the leg, then forms a loop sustaining the lower end of the tin; thence it runs up with its sticky side outwards

and adherent to the inside of the surrounding strips; lastly, for more security, it turns down over the last circular piece, its inner side adhering to the outer surface of those strips. Thus we have at the upper part of the leg a fixed point, the wire eye supported through the medium of the tin by a loop of plaister, which takes its bearing in such a manner that no constriction of the limb can be produced, whatever downward force be exerted upon the wire. Now it is only necessary to choose an india-rubber spring of such length as to produce the right amount of tension, and to fix one of its hooks in the wire loop, and the other in the eyelet which was let into the plaister on the foot. (Plate I, fig. II and III.)

By the tension of this india-rubber we can assist any one muscle or muscles in their action on the foot, making them adapt themselves to a normal posture in an active condition. If we wish to supply two muscles, *e. g.*, the tibialis posticus and anticus, two tins and two wire loops are as easily fixed as one. But a little difference must be observed in supplying the peroneus longus and brevis. These run so equally and closely on the leg that one wire loop suffices for both; but below the fibula they make a bend of a little more than a right angle, and we cannot, as is the case with other and less crooked tendons, produce the necessary change in the direction of the force by the trapezoid shape, and the adhesiveness of the strapping. That which represents these tendons must be laid on the outside of the foot, nearly as far forward as the root of the toes, and to its eyelet must be fixed a piece of catgut, which in passing to the spring runs through a little metal block, thus constructed. An eyelet is nipped by the proper pliers as though for fixing it, but without fastening it to anything; this is to act as a pulley. It is tied, not too tightly, by a piece of wire to a hole at the lowest part of the front edge of the tin. Of course, the catgut running through this barren eyelet bends at an angle, which can be made precisely to imitate that of the tendon. In these cases, the

tin should be passed into a slit in a piece of the strapping going round the leg, so as to resist the slight tendency forward. (Plate I, fig. IV and V.)

It appears to me that this paper has already reached the limit which it is desirable not to overstep, but it must be permitted me to say a few words on the application of this principle. A case of varus is to be treated by supplying force to the two peronei muscles; it is better to use a spring for each muscle, and the amount of traction should be distributed between them, until the due balance is obtained. On the other hand, valgus is treated by giving greater effect to the anterior and posterior tibials; in severe cases to both, in milder cases to the former only. Two tins and two wire loops should be used, except in the case of infants, when one tin, broader above than below, and one broad loop will suffice. The common and very inconvenient deformity called flat-foot may be conquered in a week or two by supplying power to the tibialis anticus, and the treatment relieves the patient of pain so completely that one who limps to the surgeon will walk away upright and freely. Nothing has struck me with greater astonishment than to observe that tenotomists counsel the division of this tendon; for this muscle, above all others, is that which by lifting the inner cuneiform and metatarsal bones from the ground, keeps up the arch of the foot, and aids in preventing the outward twist of valgus, which is always more or less present in flat-foot. One reads in books that this painful affection is produced by relaxation of the ligaments, although it is well known that the ligaments are merely secondary assistants to the muscles, and that their yielding is only an effect, and not a cause. Even the elongation of the plantar fascia is in these cases simply a sequence of muscular debility.

In equino-varus or equino-valgus, it may be necessary to divide the tendo Achillis, but only when the extension is severe and well marked; otherwise the treatment should be undertaken for the other tendons, as though no equinal deformity were present.

In treating an infant, very little force is required, certainly less than when a *sabot* is used, since it is applied in the normal direction. During the first few hours, it is well to apply less force than is intended to be used in the subsequent treatment. I have never found the amount of pressure influence the growth of the bones. If the child be old enough to walk, he should be encouraged to do so as soon as the treatment begins to have any effect on the posture of the limb; since the weight of the body will then aid in the cure. This is further advisable for the following reasons. When deformities are treated by irons and shoes, which confine the bones of the foot, the muscles remain inactive, and merely contract to their new position in a passive manner; such distortions, when the limb is again used, are very apt to return. To combine exercise with the treatment above indicated increases the muscles; they accustom themselves to activity in their new relations; when the apparatus is discontinued, the deformity has no tendency to return. Lastly, the faulty posture must be somewhat reversed, and the patient encouraged to walk with the foot in its new position before the treatment is finally abandoned.

I subjoin a short account of my cases.

Case I.—Jane Evans, æt. 10 months, was brought to me at the Charing Cross Hospital with a non-congenital varus of a somewhat severe description, January 18th, 1861.

It appeared that a little less than a month previously the child had had some fits, and that the foot then seemed turned a little; that nine days ago she had a more severe fit, and then the foot became worse. Some arnica, ordered by a homœopathic practitioner, had not produced any marked effect.

There was a strong bend in the middle of the inside of the foot, and the line of the toes was rather perpendicular than horizontal. There was also a great projection of the cuboid.

I dressed the limb in the manner described for supplying the long and short peronei. The application of the spring to the strap which represents the long one, had a marvellous effect in turning the sole down and unfolding the medio-tarsal bend; the influence of the other was less marked, but still effective.

January 23rd.—The foot is more changed in shape than I had expected it; the mother was obliged to take off the spring during the first night or two, but not afterwards. The leg has been washed and rubbed for some time; there is a little abrasion under the end of the tin. I dressed the limb again with a little pad of lint over the abraded part, and applied a little more power.

30th.—Foot a good deal better in form; the first night the spring being tighter was taken off, to give the part rest, but after that time it was not found necessary to remove it.

March 19th.—The history of this case consists simply in a constant gradual improvement; the child is now very nearly a year old; when she is placed standing, but supported, on the table, the sole of the foot is still found to turn a little to the inner side. The inversion is, however, but very trifling, and slight force obliterates it; the inner margin of the foot is also a little hollow. The same apparatus was reapplied so as to turn the foot almost into a valgous position, and the mother was told to let the child begin to feel its feet.

April 3rd.—The child's foot was perfectly restored. Discharged.

Case II.—Anne Payne, æt. 2 years and three months, affected with valgus, sufficient to allow the inner ankle to come almost to the ground, was brought to me at the Charing Cross Hospital, April 19th, 1861. I dressed the limb so as to supply the tibialis anticus. The child suffered no pain, but held the leg with an awkwardness that began to wear off before she left the room.

April 26th.—The position of the foot was better, and

the arch more formed, still it was not quite right. I added another spring for the tibialis posticus.

May 8th.—I have seen this child twice since the last report; she places her foot very much better, indeed the mother thinks that she is cured.

June 7th.—The child walks quite straight. Discharged.

Case III.—Alice Weston, æt. 16, came to me at the Charing Cross Hospital, May 17th, 1861. She had a considerable degree of *valgus* of the right foot, and walked very lame, which prevented her getting a situation. The inner malleolus was very protuberant, the arch of the foot was quite gone, and she had severe pain under the scaphoid and internal cuneiform whenever she bore any weight on the limb.

May 22nd.—The strapping had somewhat excoriated the skin, and the edge of the tin pressed a little over the tibia, where it begins to enlarge towards the malleolus. There was a little excoriation or blister (separation of the cuticle) in that situation. The pain under the sole was hardly to be complained of. In dressing the part again, I applied lint with a very little simple ointment over the excoriated part, and bent the lower end of the tin a little outward, placing one of the circular pieces of strapping between it and the dressing.

June 10th.—Has been seen twice since the last report. On the 3rd inst., when she was last here, I observed that the action of the succedaneum for the anterior tibial was too great in proportion to that of the posterior. I made the necessary change in this respect. The pain under the scaphoid was quite gone. She walked from Peckham to the hospital, while, two months ago, she had been quite unable to walk at all more than a few yards.

July 29th.—The patient has been here of late only every fortnight. She has a situation, and cannot come so often as before. The foot is very nearly straight, the arch is still rather low, but very little lower than in the other foot.

August 21st.—Discharged cured.

Postscript.

June 11th, 1862.

Since this paper was read, several additional cases have been treated in the same manner by the author. From among them, he would select the following instance of congenital varus.

Margaret Lynch, æt. 3½ years, came into the Charing Cross Hospital, with varus of the left foot, and was placed under my care February 18th, 1862. The child was of a very irritable temper, and cried through the greater part of the day and nearly all night, although she was undergoing no treatment, and was kindly managed.

The varus was congenital. The sole looked inward and backward; the cuboid and the external malleolus projected much; the internal malleolus was hardly to be seen. The foot was so twisted that when the child was held erect on the right foot and persuaded to put the other to the floor, the malleolus very nearly touched the ground; the cuboid was made the point of support, and the great toe nearly touched the inner edge of the tibia.

February 22nd.—I began to treat this child, supplying the peroneus longus and brevis with india-rubber springs; even a slight force made a good deal of change.

24th.—I supplied shorter india-rubber for the purpose of making more extension. The foot was already improved. I had her dressed, and encouraged to walk about.

28th.—The foot was much improved, and the medio-tarsal bend unfolding. The child had become wonderfully good since the 24th. I readjusted the apparatus. The child has taken to crying in the night, and as I had a severe operation in the ward, I sent her out of the hospital.

March 20th.—Strapping was readjusted on the foot only on the 6th; she was then able to walk very fairly, while the sole came well to the ground, but she had a tendency to turn the foot in. I somewhat inverted the mal-

position, and told her parents to encourage her to walk. She had grown very much better tempered, and the calf had much increased in size.

April 22nd.—There was only a gradual improvement to report in the position of the foot; the child walked now very fairly. She was, however, out of health, had been growing very fast, and had bowel irritation and debility; the hot weather seemed to be one cause of this. After a little aperient medicine, cod-liver oil and steel were ordered, and the india-rubber left for a day or two rather less tight.

May.—In the middle of this month the child's foot was quite restored. The patient had been kept in bed during only the first two days of the treatment.

DESCRIPTION OF PLATE I.

N.B.—The feet are drawn in a healthy condition, to allow the positions of the appliances to be more readily seen.

Fig. I.—The first steps in the treatment of valgus.

A. A trapezoid piece of plaister, with an eyelet in its upper end, adherent to the foot in the position of the tibialis posticus tendon.

B. A similar piece, adherent to the foot over the former, to supply the place of the tibialis anticus tendon.

C. A broad and long piece of strapping adhering over the tibialis posticus muscle. The rest, nearly twice the length of the limb, hangs freely down.

D. A similar piece of strapping, applied in a like manner over the tibialis anticus muscle.

E, E. Pieces of tinned iron laid upon the strapping at C and D, and roughly moulded to fit the surface.

F, F. Wire loops fixed in the upper part of each piece of tin.

Fig. II.—An advanced stage in the treatment of valgus. Circular strapping has been applied to the foot, and in part upon the leg also; in the ordinary course the whole leg would have been covered, but here only four circular strips have been represented, the rest are left out in order to show the disposition of the longitudinal strapping.

G. Strapping surrounding the foot, and covering the plaister visible in Fig. I, A and B, except the ends with the eyelet holes, which are free at A and B.

H, H. The arrangement of the longitudinal strips, the ends which, in Fig. I (C, D), hung loose, are here turned up and lie over the tin, with the sticky side outwards. Thus they each form a loop under the lower end of the tin to support any downward pressure.

J. The wire loop protruding through a hole cut in the strapping; it is equally or even more convenient to let it project between two contiguous strips of plaister.

K, L. India-rubber springs, fitted to their place as though the other arrangements were finished. K is to replace the tibialis posticus. L is to reinforce the tibialis anticus.

Fig 1

Fig 2

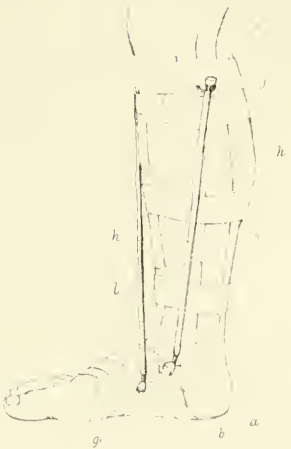

Fig 3.

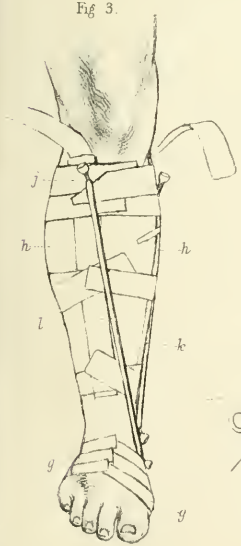

Fig 4

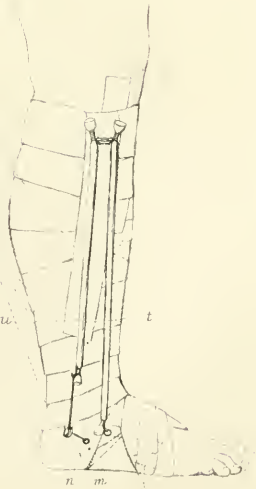

Fig 5

DESCRIPTION OF PLATE I—(*continued*).

Fig. III.—The same limb, in the same stage of treatment, seen from the front. The lettering is identical.

Fig. IV.—The treatment of varus, complete.

M. The upper end, with an eyelet-hole, of a trapezoid piece of plaister; the continuation of which under the circular pieces is marked by dotted lines, and which adheres over a rather broader surface of the sole than the insertion of the peroneus longus.

N. The end, with the eyelet, of a piece of plaister, representing the insertion of the peroneus brevis; its continuation is marked with dotted lines at N′, as being split so as to embrace the head of the metatarsal bone.

O. Circular strapping, covering but one piece of tin placed just behind the fibulair, with its layer of plaister on either side.

R. The remainder of the longitudinal strip of plaister brought down and adherent to the outside of the circular ones.

T. An india-rubber spring assisting the peroneus longus.

U. An india-rubber spring assisting the peroneus brevis. At the lower part of U, is an arrangement for changing the direction of the force; this is better seen in Fig. V.

Fig. V.—Arrangement for changing the direction of the forces in replacing the tendon of the peroneus brevis.

V. The tin which is laid on the longitudinal strapping.

X. An eyelet fastened by wire to the lower and posterior angle of the tin.

Y. Catgut passing from the lower end of the india-rubber spring to the strapping representing the attachment of the tendon. It is bent in the direction of the tendon of the peroneus brevis.

CONGENITAL MALFORMATION OF THE EYES

IN THREE CHILDREN OF ONE FAMILY.

BY

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Received Nov. 12th.—Read Nov. 26th, 1861.

A CASE in which there was *Irideremia totalis* having been brought under the notice of the Society during its last session by Mr. Hulme, it may, perhaps, not be without interest to some of the members if I shortly relate a case of this not very common deficiency. The case, which I had previously seen, and which I still watch, occurred in the person of a stout, well-grown boy, who, when I first saw him in September, 1860, was thirteen years old. Shortly before this date, a sister, aged fifteen, had been brought to me, in whom I found considerable congenital malformation of both eyes.

Both these young persons were thought by the parents to have weak sight, but in neither was it suspected that the eyes presented anything unusual.

The girl had been sent to a boarding-school only three or four weeks before I first saw her, having previously attended a village school, and not kept close at lessons. The teachers at once noticed that she had considerable difficulty in seeing the print, and that close application to her books soon became painful to the eyes, and made them watery and red.

It was for the relief of this irritable condition that my assistance was sought.

I found both globes smaller than natural, not perfectly round, but somewhat flattened by the recti muscles, and rather soft to the touch. The sclerotic coats were very vascular; both the corneæ conical; the irides dull, thin, and tremulous; the pupils not in the axis of vision, but placed considerably to the nasal side, and, though acting under varying degrees of light, doing so sluggishly and imperfectly. Both eyes were myopic, particularly the left, in which the sight was the most imperfect.

Though she was a well-grown girl, the general health was feeble. By the use of tonics, mild local astringents, and gentle counter-irritants, protecting the eyes from strong light, and abstinence from study, the irritation subsided, and the health improved. She soon became, and still continues, quite equal to ordinary domestic occupations in a farm-house, and can both read and sew with comparative ease.

An elder sister, who accompanied her, had a similar congenital condition of the eyes, but in a much less degree.

On my inquiring as to the other members of the family, I was told of a boy "who had rather weak eyes, nothing else." I requested him to be brought to me, and I found in him a total absence of the iris in each eye. If the ciliary processes were at all developed, they were so in a very slight degree, being too small to be seen. The choroid appeared to be normal: in an ordinary light it was of a dense black colour; with the ophthalmoscope the vessels were seen to be beautifully developed. The retina appeared to be natural, and the lens in each eye was then perfectly transparent, with the margin clearly defined and distinct. Though the sight of the right eye was much more imperfect than that of the left, no organic difference could be detected between them. With the left eye he could see very fairly; so much so, that he had regularly attended the village school, and learnt his lessons like other boys. A strong light was unpleasant, but he did not court a very subdued light. Neither convex

nor concave lenses improved the sight, and diaphragms of all sizes and of any material, soon caused the eyes to feel hot, painful, and watery, without in any degree improving vision.

On my next seeing the boy, a few weeks afterwards, I found the right lens becoming muddy; and, at the present time, cataract has become fully developed. As it has a strong crystalline character, and as the whole lens is visible, showing an expansion cocqual with the cornea, the cataract gives to the eye a peculiar appearance.

The left eye continues in the same condition as when first seen, fourteen months ago.

The father and mother have both good sight, and they do not know of weakness in any of their elder or contemporaneous relatives; but I should mention, as showing a strong hereditary tendency in this family, that some years ago I operated for congenital cataract in a first cousin (on the mother's side), where, in addition to the opacity in both lenses, I thought the globes were smaller than natural. Although this child did well and gained good sight, it subsequently died from an affection of the head. This was an only child, and I believe the three compose the other family.

OBSERVATIONS ON THE DIVISION

OF THE

GUSTATORY NERVE,

AND ON LIGATURE OF THE LINGUAL ARTERY, IN THE TREATMENT OF CANCER OF THE TONGUE.

BY

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In the year 1850 Mr. Hilton published in the 'Guy's Hospital Reports'[1] a case of cancer of the tongue, in the treatment of which he had divided the gustatory nerve on the side of the disease. The advantages which he looked for were :

"1. To destroy the sensibility of the ulcer, so as to enable the patient to take food.

"2. To reduce the flow of saliva, which was very distressing.

"3. In the hope that the pain experienced over the distribution of the fifth nerve might be immediately relieved.

"And, 4. To render the operation of sloughing off the diseased portion of the tongue by ligature void of pain."

No ligature being eventually used, the fourth-named benefit of the operation was not tested : the first three advantages were obtained, and they continued for a month. Yet so completely has this operation fallen into disuse, that in a description of the treatment of cancer of the tongue in the seventh volume of the third series of the same work, no allusion is made to the division of the sensory nerve.

[1] Second series, vol. vii, p. 251.

I cannot discover that any other surgeon has repeated this operation. Having practised it myself, however, in five cases of cancer of the tongue, I have formed a high estimate of its value, and am convinced that much suffering would be temporarily alleviated, if the safety and facility of this method of relief were more generally known.

In deciding on the employment of this remedy, it is important to discriminate between the various sources of the pain in cancer of the tongue. There is the darting, electric pain in the tumour itself. There is the sensitiveness of the cancerous ulcer to all contact with the teeth, or with matters taken into the mouth. There is the suffering due to the ceaseless movements of this muscular organ, and to those of the jaw, when the tongue is adherent to it. There is the anguish occasioned by the encroachment of the disease upon the nerves, and sometimes by their ulceration and exposure. The parotid region, that of the ear, the temple, and the crown of the head, are sometimes as much complained of as the tongue itself, for the fifth nerve sympathises through many of its branches with the irritation of its gustatory portion. The glosso-pharyngeal and the sympathetic nerves have doubtless likewise their share of pain. At the same time the salivary glands, stimulated by the irritation of the fifth nerve, pour forth a copious and constant flow of saliva, which, in some cases, amounts to two pints or more in twenty-four hours, and by the expectoration of which the other pains are aggravated. Added to all this, there is often a train of painful symptoms connected with suppurations in the primary tumour, and with the growth, adhesions, softening, and ulceration of secondary glandular disease; besides the distress arising from the fœtid state of the mouth, and the great and increasing debility of the patient.

All these causes of the peculiar painfulness of cancer of the tongue may not exist together: in some rare instances there is, even during ulceration, no pain or salivation whatever. But when they do exist, their separate causes can be discriminated, and for some of them decided relief can

be afforded. The symptoms which depend on the glosso-pharyngeal nerve can be distinguished from those attributable to the gustatory; and, while no surgical remedy short of the extirpation of the root of the organ can be directly applied to the former nerve, the greatest relief and ease can be obtained for the fifth. Nothing is necessary but to sever the gustatory nerve between the disease and the brain. No sensation can then be conveyed along it from the tumour; no reflected irritation can reach its collateral branches; no stimulus to an exaggerated secretion can be given to the salivary glands. A patient, on whom this operation has been performed, should be relieved of pain in the tongue in front of the fauces, as well as in the jaw, temple, and crown of the head; he should lose the incessant annoyance arising from the dribbling or expectoration of the saliva; should speak more freely, and swallow with less difficulty, should sleep better, and be better nourished than before. And, so far as the gustatory nerve alone is concerned in the disease, all this is usually and strictly the fact. The glosso-pharyngeal, however, cannot be relieved by this operation, except as, indirectly, its pain ceases to be made worse by the salivation and consequent movement of the tongue.

The feasibility of this plan for affording relief arises from the superficial position of the gustatory nerve. From the point at which it emerges from between the internal pterygoid muscle and the jaw to that at which it enters the tongue, the nerve is placed immediately beneath the mucous membrane of the mouth. In the hinder part of this submucous course it lies between the last molar tooth and the anterior pillar of the fauces; further forward it is beneath the floor of the mouth. Mr. Hilton, in his operation, sought for the nerve in the latter situation. The tongue being pressed away from the jaw, he made an incision along the mucous membrane thus exposed, found the nerve close to the sublingual gland, raised, and divided it. This operation is a sure one, inasmuch as the nerve is actually seen; but he describes it as rendered tedious by the bleeding and

it appears, further, to be inapplicable when the tongue is fixed to the jaw by adhesions of the tumour. There is a spot further back in the mouth, in which also the nerve is within reach, and where it can be divided even when the size of the tumour renders the operation in the floor of the mouth impracticable or inconvenient. The nerve, indeed, cannot be seen in the operation, but it may sometimes be felt, and can generally be easily reached.

The guide to the nerve in the latter situation is the last molar tooth. On passing the finger into the mouth within and beyond that tooth, the bulging alveolar ridge can be felt, narrowing as it ascends into the thin coronoid process. Behind, below, and parallel with the ridge, is the nerve. A line drawn inside the lower jaw, from the crown of the last molar tooth to the angle of the jaw would cross it at right angles about half an inch from the tooth. An incision, therefore, in the direction of such a line, three fourths of an inch in length, and carried through the mucous membrane to the inner surface of the bone, must divide the nerve. It is advisable to operate with a curved bistoury, since the alveolar ridge would shield the nerve from the edge of a straight knife. It is also advisable to be exact in observing the position of the alveolar ridge, or, in its absence, the edge of the toothless gum curving up to the ramus. In one of my earlier cases, in which there were no teeth to serve as a guide, I cut too far back, and missed the nerve, being probably misled by a mass of the tumour which was adherent to the inner side of the jaw.

Case 1.—A slender, pale, sallow, red-haired Scotchman came into the Middlesex Hospital under my care, late in June, 1861, for cancer of the tongue. The disease occupied almost the whole organ: a small portion of the tip of it was still healthy, but all else that was visible was a mass of hard tumour, partly ulcerated, partly covered with thin, dark-red, scar-like, mucous membrane, or with thick tenacious mucus and epithelium. There was a deep ulcerated hollow on the left side, about the middle, and behind

this the posterior and left side of the tongue could be felt to be still unaffected.

The poor fellow suffered severely. The pain, which had at first affected the left temple, had changed sides with the disease, and he now had much pain in the tongue and the right side of the jaw and temple, and a soreness of the whole crown of the head. He expectorated with difficulty about a pint and a half of saliva in twenty-four hours. He had scarcely any sleep, and took very little nourishment. Some cervical glands on both sides of the neck were hard, swollen, and tender.

July 3rd, 1861.—I divided both gustatory nerves behind the last molar teeth, with a curved bistoury. For a few days he complained of soreness in the situation of the incisions, and he still had deep pain in the back of the tongue and throat; but, with these exceptions, he was instantly and in every way relieved. The flow of saliva was at once arrested. The pain in the head was completely gone. He took food with comparative ease, and was able to sleep; and it was interesting to observe that, as his general health and nutrition improved, the sallowness of his countenance, which had appeared to indicate the fabled cancerous cachexia, gave place to a look of health. His tongue was frequently examined, and it was found to be absolutely without feeling throughout the part supplied by the gustatory nerves. The dorsum and sides in front of the fauces were quite insensible even to a prick or a scratch which made the surface bleed. The patient himself spoke of the tongue as being quite benumbed and painless, and he moved it about without reserve in his efforts to speak. He was not entirely without pain, but his state for a month after the division of the nerves was very much more comfortable than before. He himself was quite decided as to the value of the treatment to him.

August 15th.—The tongue is still insensible to touch, and to the taste, as well as the touch of sapid substances placed upon it. None of them appear to stimulate the salivary glands in the least. On one occasion since the

operation he has complained of pain in the crown of the head, but it soon passed away, and did not return. He is, however, in much pain at present from the disease in the root of the tongue, and from the advance of disease amongst the glands of the neck.

During the last month of his life parts of the tongue sloughed, and hæmorrhages occurred from the ulcerated parts. The disease in the cervical glands grew rapidly, and suppurated. Salivation returned. Great weakness and cough came on. At length he became quite unable to swallow nourishment, and he died exhausted, September 13th.

At the post-mortem examination very little of the tongue was found remaining. There were several nodules of apparently medullary cancer in the lungs, and gray hepatization of two thirds of the lower lobe on the right side. Both gustatory nerves were found to have been divided, and their extremities terminated in masses of dense lymph.

Case 2.—On the same day I admitted another man, suffering from the same disease. He was somewhat stout, for his disease was recent as compared with that in Case 1; but he was pale from want of nourishment, and had an appearance which betokened great suffering and dejection.

The primary tumour was a flat, thick, firm, cancerous mass on the right side of the tongue, presenting one surface outwards, which was entirely ulcerated, and its edges superiorly and inferiorly. The disease was limited to the right half of the organ, and was still at some distance from its mesial line. It extended from the level of the anterior pillar of the fauces to the canine teeth, behind which the right molars and bicuspids of both jaws had been extracted. The whole parotid region and the adjoining parts of the neck were swollen by a large mass of secondary glandular cancer, which, behind the angle of the jaw, projected as a soft abscess, covered with thin, red, and very tender skin. This man's principal suffering appeared to be connected with the secondary tumour: it much restricted the movements

of the jaw, and it appeared to pass inwards and hinder his swallowing and speaking. It was, however, impossible to make out the state of the fauces and pharynx. He never spoke, but always wrote what he had to say. The salivation was profuse, and increased his distress: in five hours he expectorated half a pint of clear saliva.

July 3rd, 1861.—I gave him chloroform, and divided the right gustatory nerve. The ulcer and the right half of the tongue, as well as the gum, became at once perfectly insensible, and the salivation ceased. The pain, however, appeared to be but little relieved, for it was principally due to the state of the secondary tumour. Some days after the operation, when the skin of the neck had given way and a great part of the softened *débris* had been discharged from the interior of the glandular mass, he was very greatly relieved, and he then recognised the ease which he enjoyed in the absence of salivation and of pain in the tongue. On some days he spoke freely, and almost as if there were no disease in the organ; on other days, without a renewal of pain, he found that he could not venture to do so. Early in August the renewed activity of the secondary disease began occasionally to cause him fresh distress. The tongue, however, was almost painless. He said that sometimes, when awaking from sleep, he found himself chewing it between his toothless gums, but that the compression gave him no pain.

August 15th.—I tested the healthy mucous membrane in the front part of the right side of the tongue with sugar, salt, citric acid, cayenne pepper, and aloes. He was absolutely unconscious not only of their qualities but of their presence, so long as he kept them on the right side of the tongue and the mouth open. When, however, the last two touched the hard palate, and the first three passed to the left side of the tongue, he became aware of their presence and of some of their qualities.

On the 14th of September this man died, apparently exhausted by the secondary disease. The tongue was little more invaded by the tumour than it had appeared to be

when I first saw him. He had gray hepatization of the lower half of the lower lobe, with pleurisy, on the left side.

The incision in the mucous membrane of the mouth had healed, being no more than a narrow depression, a quarter of an inch long. The nerve had been completely divided. Its extremities lay in a common mass of lymph, but did not meet in it, as they were not directed towards each other. The proximal portion was of natural size, and red: the part beyond the section was white, and decidedly smaller than the corresponding part of the opposite nerve.

Case 3.—John B—, æt. 62, was admitted into the Middlesex Hospital, August 23rd, 1861, on account of an ulcerated cancer of his tongue.

Four months before admission he noticed a little soreness on the right side of his tongue, and he soon afterwards began to be annoyed by a copious secretion of saliva, which no gargles restrained.

At the time of his admission the disease was a flattened hard tumour, situated superficially on the right side of his tongue. Its surfaces were directed inward and outward. Its vertical measurement was about three quarters of an inch; in its longer diameter, from before backwards, it reached from the level of the bicuspids nearly to that of the anterior arch of the palate. It was not attached to the jaw; yet the limits of its deepest part towards the root of the tongue could not be clearly defined. There was no trace of disease in the glands beneath the maxilla or in the neck.

Nearly the whole external surface of the tumour was a flat ulcer, pink in colour, and covered with small papillary granulations. It was not indented by the teeth, and it was moderately, not extremely, sensitive when touched. The man looked haggard and ill from pain and want of rest, and walked about holding a handkerchief to his mouth, which was constantly overflowing with saliva. This flow distressed him, particularly at night, soiling his bed and preventing his rest. He complained of pain in his tongue,

but more of that in the right ear, temple, and crown of the head, in which situations it was severe and almost unceasing.

This case was one in which, if in any, some advantage might have been hoped for by the extirpation of the disease. There was no trace of any secondary affection, and the tumour was of recent growth. It had, however, already involved an indefinite extent of the root of the tongue. On this ground, and on account of the usual failure of the operation in affording even relief for any proportionate time, I determined to adopt the plan which it is the object of this paper to recommend. Accordingly, on the 24th of August, I divided the right gustatory nerve in the usual place. Some little difficulty attended the operation in this man on account of the projection inward of the last molar tooth of the lower jaw. The ordinary curved bistoury was not sufficiently bent for me to cut quite down to the bone behind the tooth, and I could feel the nerve, exposed by the shallow incision through the mucous membrane, and roll it on the bone. When it was divided, however, nothing could be found in the base of the wound but the bone covered with periosteum.

Upon going to the patient about ten minutes after he had returned to the ward, his first and spontaneous remark to me was that since the operation all his salivation had ceased. And further demonstration of the relief afforded him, and of the division of the nerve, was many times presented in other ways. For, first, his former pains were completely gone. The tumour no longer ached, and the ulcer was no longer sensitive. He had no longer any pain in the course of other branches of the fifth nerve; he ceased to suffer in his ear and temple and head. He could articulate more easily, and he obtained refreshing sleep. The tongue had become absolutely insensible to a touch or scratch on its right side and anterior half, and neither sugar, salt, citric acid, aloes, nor cayenne pepper, aroused in that part the sense of taste. The floor of the mouth and inner gum of the right side of the lower jaw were also absolutely without sensation. In one particular, indeed, this

loss of feeling annoyed him; for, while he could masticate without pain, he could not easily control the food if it passed to the benumbed parts of the mouth.

All this relief, and all these evidences of the division of the nerve, were not obtained at once, though they were constantly present for many weeks afterwards. He suffered in an unusual degree after the operation of dividing the nerve, which, as has been said, was not accomplished without several sweeps of the knife; and considerable swelling at the floor of the mouth attended this and a later operation, which must now be referred to.

The cases are not numerous in which cancers of the tongue present themselves in hospital practice before some indication of secondary disease exists. Upon observing, however, that no glands were involved in the disease in this instance, and that the whole tumour was probably seated within the area of the branches of one artery, I became desirous of ascertaining the effect upon the tumour of temporarily reducing its supply of blood, *in addition to* that of annihilating its sensation. No organ could be more convenient for this observation than the tongue, the nerves of which are separate, and two of them accessible by operation, whilst the artery is also within reach, and by no means free in its anastomotic communications with other arteries. It appeared to me that, if the natural process by which cancers are sometimes observed to wither could be imitated, it might be done by the simultaneous withdrawal of two such important elements of nutrition as blood and nervous influence, and that this withering should happen, if anywhere, in the tongue, when the gustatory nerve was severed and the lingual artery tied. It occurred to me to take the opportunity of dividing also the hypoglossal nerve, but as that proceeding could have had no beneficial effect beyond that of affording a little quiet to the tongue by paralysing some of its muscles, and as the patient would have been permanently placed by it in the unpleasant condition, as regards articulation, of a person suffering from hemiplegia, I decided not to adopt it. I tied the lingual artery on the side of the disease, on the 26th of

August. The operation presented no peculiarity worthy of observation, unless, indeed, the difficulty in reaching a vessel so easily tied is worth mentioning. This difficulty arose from the yielding of the bottom of the wound under pressure, and from the depth at which the vessel was situated, there being considerable œdema of the neck, following the operation of dividing the gustatory nerve on the day but one previously.

During the first week John B— suffered a good deal of pain in the throat and beneath the chin from the swelling and inflammation consequent on these operations. He had difficulty in swallowing, and the salivation, which had ceased entirely until twenty-four hours after the second operation, began then to return again, and reached about half what had been its amount before the first operation. By the end of the week he was spitting a pint of saliva a day. His pulse averaged 78. There was no marked change in the appearance of the ulcer, though, perhaps, it looked a little paler than before.

In the following week he slept well, and improved in health; he was relieved of his pain, and began to take food. The daily salivation varied from three to five quarters of a pint.

In five weeks from the time of the second operation it was satisfactorily established that the tumour was smaller in size than it had been before the operations. Its ulcerated surface, however, was no less vascular, and was not healing, and the two sides of the tongue were equally red. The diminution in size was distinct, but did not exceed one eighth of the former bulk of the tumour.

At the end of the second month after the operations the complete relief from pain continued, and the salivation remained at about half its first amount, rarely exceeding a pint a day, and not incommoding him during his sleep. The tumour was slowly and slightly increasing in size. I proposed to him to have the left lingual artery tied, in order again to arrest the progress of the tumour, but he was afraid to incur again the pain which the first two operations

had caused him. He was quite content with the amount of relief which he was enjoying at the moment, and he declined to submit to any further operation.

November 4th.—At the end of ten weeks the insensibility of the right side of the tongue and of the ulcer remained complete, the salivation moderately inconvenient, and pain entirely absent. The tumour, however, continued to enlarge, increasing towards the middle of the tongue, and a cancerous gland was distinguishable in the right submaxillary region.

REMARKS.

1. *The division of the sensory nerve.* The occasion for performing this operation does not arise in all cases of cancer of the tongue. There are a few examples of the disease in which the characteristic pain in the fifth nerve is entirely absent. They are cases in which sometimes no pain whatever is felt, and which, however large the mass of the disease, are not universally admitted to be of cancerous nature. The absence of pain appears to be chiefly explicable by the relation of the ulcer. It is on the dorsum, perhaps on the central line, of the tongue. It penetrates deeply into the morbid mass, and into the substance of the tongue, but being surrounded by a solid wall of new substance it moves little with the muscular fibres of the organ. Its edges, moreover, are folded over the sore, and its orifice so small that the tender surface beneath is protected from all irritating contact. The instances, on the contrary, which are attended by great and characteristic suffering are those in which the ulcer is superficially placed at the side of the tongue. Spread out on its rigid cancerous base, it is scraped, rubbed, or pressed incessantly against the teeth and other foreign bodies. Even ulcers which are certainly not cancerous may be painful when thus situated, and may be attended by the peculiar radiating irritation of the fifth nerve. These last cases being curable by medicine, the

operation of dividing the nerve is not required for their treatment.

Of all palliative methods of treatment which cancer of the tongue admits of, none is to be compared for its efficacy with the division of the sensory nerve. The relief is not temporary, as that afforded by anodynes and local applications necessarily is, but it is continuous. The influence of the operation extends as far as the area of the fifth reaches, and lasts as long as the nerve continues dissevered. In my own cases it did not appear that the nerve ever re-united, and pain was only renewed by the glosso-pharyngeal, or by the advance of the disease to the neck. The loss of sensation was complete. One of the men often found himself involuntarily "chewing" his carcinomatous tumour between his gums. If his perception of so great an injury was destroyed, he must also have been spared those lesser, but ceaseless and wearying irritations, which every touch of the teeth, and movement of the tongue had previously occasioned.

It would be no injury to a patient with an ulcerated lingual cancer to deprive him of taste as well as feeling. Few things more nauseous can be conceived than the fœtid matters which accumulate in the mouth, and adhere to the tongue and teeth in these cases, and which often cause little less annoyance to his attendants than to the sufferer himself. Unhappily, however, that perception of the qualities of food and other matters, which depends on the glosso-pharyngeal nerve, and on those distributed in the nostrils, remains; the discharges continue to be offensive, and require correcting by odorous and sapid substances. The division of the gustatory nerve affords only partial relief in this respect; but it allows of much more thorough and frequent cleansing of the mouth than could be previously endured.

The cessation of the copious overflow of saliva is a remarkable result of the operation; and not less so was the early and partial recurrence of salivation in the last case. In all the cases alike the submaxillary ganglion remained connected with the ulcer, whilst both were severed from the

brain; yet in one case salivation began again in less than a week. The nerve had certainly been divided, for it had been felt at the operation, and the tongue and ulcer had become, and still continued, absolutely insensitive, and the pain was gone. The only difference between the cases was the subsequent ligature of the lingual artery, but that affords no explanation of the recurrence and persistence of salivation. Whatever its cause, it must have been independent of the divided gustatory nerve.

The division of the sensory nerve cannot supersede the operation of extirpating the disease. Whenever that plan can be adopted with a reasonable probability of success, it will continue to be resorted to for the sake of the more complete relief which it necessarily affords. Yet there is perhaps no example of cancer in which the use of the knife or *écraseur* is more unsatisfactory than that in the tongue. A few months at most, sometimes weeks only, of ease are obtained, and the disease returns. And if the tumour be so extensive as to require the extirpation of the whole tongue with it, few operations, according to our present experience, are more fatal in their immediate issue. The division of the gustatories is a perfectly legitimate resource in some of the cases in which that severe operation may have been rejected. A partial extirpation of the tongue, on the other hand, being proper only when the disease is recent and can be completely isolated, will not interfere with the performance of the operation in question, which is adapted to a later stage, and only to certain symptoms of the disease.

It should perhaps be added, that the removal of nervous influence made no perceptible change in the nourishment or vitality of the tumour. It did not grow less, or slough more, than before.

2. *The ligature of the artery.*—The effect upon the tumour produced by the ligature of the lingual artery was much more decided than that of dividing the nerve. The ulcer was at first paler, and the whole mass of the disease perceptibly shrank. The result, however, was not permanent, and, after five weeks, the tumour began to grow again. Any

eventual advantage which may be expected to accrue from this operation is limited, therefore, to a diminution of the hæmorrhages which often attend the later stages of the disease. Cancer of the tongue is indeed sometimes fatal, by hæmorrhage at a comparatively early period. The instance is well known, in which a member of our own profession delivered the Hunterian oration in February, and was suddenly cut off in August of the same year by a cancerous ulceration of the lingual artery, or one of its branches. ('Med. Times,' 1853, vol. ii, p. 248.) Hæmorrhages so severe would be prevented by a previous ligature of the vessel, and it seems reasonable to conclude from the case last reported in this paper, that the original disease might have been longer stayed in its course by the repetition of the operation on the opposite side of the neck. With lessened pain, after a division of the nerve, life may seem even to these patients more worth prolonging.

Postscript.—John B— died March 15th, 1862. He was not seen by any medical man for the last few months of his life, but a short statement of his symptoms has been procured from his daughter.

No pain in the temple or head occurred after he left the hospital, but, as the disease advanced, he complained of severe pain in his mouth. He was nevertheless able to swallow broths and stewed meats, and even on the day of his death he took a cup of milk. In January, he lost a pint of blood from the ulcerated tongue, and again a similar quantity a month before his death. After the second hæmorrhage he remained greatly exhausted, and did not leave his bed. The salivation further reduced him, that discharge sometimes amounting to a pint in the day.

Post-mortem examination.—A few glands in the neck were cancerous, and in one spot an abscess had formed, which was on the point of breaking through the skin over the right submaxillary gland. Nearly half the tongue was

destroyed. Its left side appeared healthy, but all the tip of it was cancerous, and a large, deep, uneven ulcer occupied the place of the right half, hollowed out the apparently healthy left side, and reached to the right cornu of the os hyoides. Careful search was made for the right lingual artery, but its place was completely ulcerated away. The site of the operation on the vessel was included in the subsequent ulceration, and an atheromatous condition of the external carotid obscured the origin of the lingual. This vessel having completely disappeared, it is probable that the hæmorrhage had proceeded from branches of the adjoining facial artery. Indistinct traces of the right gustatory nerve were found in the *débris* at the floor of the mouth.

DESCRIPTION OF PLATE II.

A vertical median section of the bones of the face. The inner surface of the lower jaw is partly hidden by the internal pterygoid and mylo-hyoid, between which muscles the gustatory nerve may be seen descending forward.

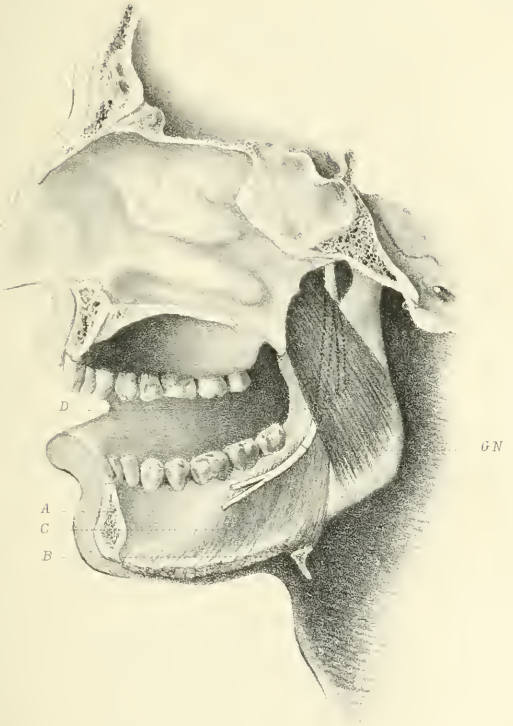
A. Symphysis of the lower jaw.

B. Mesial section of the body of the os hyoides.

C. Mylo-hyoid muscle; upper surface.

D. Internal pterygoid muscle; inner surface.

G N. Gustatory nerve, marked at the place in which it is recommended to be divided in the foregoing paper.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A CASE

OF

OSTEO-MALACIA.

BY

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COMMUNICATED BY

MR. T. B. CURLING, F.R.S.

Received Nov. 14th.—Read Dec. 10th, 1861.

In the 'Medico-Chirurgical Transactions' is to be found a great part of all the original information that has been contributed by English authors concerning that rare and formidable disease, osteo-malacia. This fact has suggested the desire to acknowledge the benefit I have derived from that source, by submitting a very interesting case observed by myself, to the Society.

Mrs. W— came under my care in June, 1860, as an out-patient of the London Hospital, having been transferred by my colleague, Dr. Parker. She was then forty years of age; had been married ten years, but had never been pregnant. She belonged to a healthy family, and had herself enjoyed good health until nine years ago. Then she began to suffer from a series of colds. About eight years back she had a severe illness, described as inflammation of the chest. For this she was salivated. She says she has never

thoroughly recovered. After this illness she had an attack of erysipelas. Three years ago, suffering under a cough and difficulty of breathing, she went to the Victoria Park Hospital, and came under the care of Dr. Birkett. She subsequently came under the care of Dr. Andrew Clark, at the London Hospital.

The first symptom she complained of was persistent and excruciating pain in the dorsal and lumbar vertebræ. She had suffered from this pain when she had applied at the Victoria Park Hospital, but she had not at that time lost stature, and did not manifest any symptom to lead to a suspicion of the true nature of her disease.

When she presented herself to me she walked in painfully, supported by her sister. Her original height had been five feet eight inches; she now barely measured four feet eight inches. Her sister was a tall, well-proportioned woman. Both agreed that Mrs. W— had been the taller of the two.

Present symptoms.—Is racked by pains in the bones, which are thought by those about her to be rheumatic. This, however, she says, is not her own opinion. Walking is very painful, she is easier when sitting, but cannot get up without great trouble. She is liable to attacks of sickness. She has always been accustomed to "bilious attacks." She has pyrosis in the morning, and retching. The right leg swells towards night. She spits blood at times. Menstruation has always been scanty.

She was ordered a drachm of syrup of diphosphate of zinc and iron, and good diet, with wine. Under this treatment she appeared to improve, and is reported at her visits on the 14th July, 18th August, and 26th September, to be stronger, and better in every respect.

On the 20th October, although otherwise doing well, she complained that the sickness was more troublesome. Omit the zinc: take oxalate of cerium, two grains twice a day. On the 31st the sickness had been quite relieved, but the right leg still swells much towards night. The use of the diphosphate of zinc was resumed.

On the 1st December she complained that sweet medicines make her sick; but the sickness is more controllable. The leg swells less. She seems weak. Urine passed with pain, and generally turbid.

December 15th.—Great acidity of stomach; flushes in face after meals; nausea and vomiting soon after eating; pain and sense of coldness in chest. Ordered bismuth, hydrocyanic acid, and opium.

22nd.—Has lately complained of great pain, increased on pressure, over the left hip, where there is a spot like a bruise. The stomach is better.

January 5th, 1861.—The hip is better. The right leg is painful and swells. She has profuse leucorrhœa.

On the 2nd February there had been no marked improvement. The pains in the limbs were excessive, the legs were apt to get cold. The pains in the bones deprived her of rest. Menstruation very scanty; like "port wine."

Having recently read a paper by Dr. Breslau, in which he described a case of osteo-malacia which had been benefited by cod-liver oil, I determined to try the remedy upon Mrs. W—. To this she manifested some repugnance, saying that both under Dr. Birkett and Dr. Andrew Clark she had in vain tried to take cod-liver oil; it always made her sick. To counteract this tendency I prescribed ten minims of dilute hydrochloric acid with each dose.

During February and March she took the oil with this combination with decided advantage and without discomfort. But the pains in the limbs were still very distressing. To relieve this symptom she took a quarter of a grain of belladonna, with half a grain of morphia, at night. This did not succeed; and one grain of Indian hemp, with two grains of extract of conium, were substituted. After taking this latter combination for a week the pains were much relieved. She came to the hospital walking, feeling much stronger and better.

In May the improvement continued. She took the oil without suffering from sickness. In June she had an attack of bronchitis. In July this had disappeared; she was gain-

ing strength rapidly, was able to discharge her domestic duties, and reported herself as restored to health.

On the 16th November last she was seen by myself and Mr. Taylor, acting resident-accoucheur at the London Hospital. She was still in good health and spirits. The skeleton was minutely examined. Nowhere did pressure occasion any tenderness. Latterly she had menstruated freely and more naturally than for many years.

The physical appearance of the patient is very remarkable and characteristic. Long, thin, straight limbs are set upon a squat, dwarfed, distorted trunk. The disease seems to have spared the bones of the head, the clavicles, scapulæ, arms and legs. These parts accordingly preserve their original dimensions, and belonging, as they do, to a person originally of high stature, contrast strangely with the compressed and deformed body. The cervical vertebræ appear but little affected. But from the upper dorsal vertebræ downwards the whole spinal column is greatly distorted. An immense gibbosity rises between the shoulders; this is succeeded by a slight deviation to the left in the lower dorsal and lumbar region; there is no compensating anterior curvature. The ribs are much compressed, contracting the capacity of the chest. The sinking down of the spinal column has been attended with the fall of the chest towards the pelvis. To such an extent has this been carried that the lower ribs on either side have sunk below and inside the crests of the ilia. The pelvis is centripetally compressed on all sides. The acetabula, squeezed inwards into close approximation with the promontory of the sacrum, carry backwards the horizontal rami of the pubis, and throw out the symphysis into that peculiar beak so characteristic of mollities ossium. This beak is so pronounced that it can be seized between the finger and thumb. The obliteration of the pubic arch, the near approach of the tuberosities of the ischia, and the doubling up of the sacrum, have so narrowed the outlet of the pelvis that it is with difficulty two fingers can be introduced. As a result of the shortening of the spinal column, the three great cavities of the chest, the

abdomen, and the pelvis, are much contracted in their capacity. The chest has dropped down upon the pelvis, leaving scanty space for the abdominal organs. The deficiency is a little compensated by the protrusion forwards of the abdominal walls.

The shortening and distortion of the spinal column are obviously due to the falling in of the bodies of the vertebræ. The disease has attacked those bones and parts of bones of the trunk the bulky part of which is largely formed of cancellous tissue. The bulk of the bones has been consequently lost. Hence the falling down or squatting of the trunk.

I think the shortening and distortion made some progress during the first weeks of her attendance at the hospital.

It has often been regretted that we possess such scanty information concerning the constitution of the urine in this disease. Through the valuable assistance of Dr. Letheby, this case has been made subservient to the requirements of science in this respect. I have brought together the analyses made, in order that the results may be the more easily appreciated.

The following is the first full account of the urine. It refers to the 22nd of December, 1860, a period when the disease appeared to be still progressing and when the patient had not yet commenced taking cod-liver oil.

"The urine which you sent to the laboratory on the 22nd does not contain albumen, or the gelatiniform animal matter referred to in Dr. McIntyre's paper (and by Dr. Bence Jones, 'Med.-Chir. Trans.,' vol. xv, 2nd series). It contains, however, a very large proportion of alkaline and earthy phosphates. The general properties and reactions were as follow:

"*Colour*, very pale amber; *odour*, ammoniacal; *reaction* to litmus, very alkaline; sp. gr., 1018; *heat*, slight turbidity, but no coagulation or gelatinisation after standing; *nitric acid*, no coagulation or gelatinisation, but a deepening of tint to a dark-sherry colour; *acetic acid*, no reaction; *Fehling's solution*, no action, or sign of sugar; solutions of

lime, silver, and *barytes,* copious precipitates of phosphates, which were dissolved by nitric acid, leaving evidences of sulphates and chlorides.

"On standing, the urine threw down a copious precipitate of flocculent matter, of a white colour. On microscopic examination, this was found to consist of crystals of triple phosphates, bibasic phosphate, phosphate of lime, and oxalate of lime, the first two being dissolved by cold acetic acid, the third by boiling acetic acid, and the last remained untouched.

"The chemical composition of the clear urine was as follows:

"Water	962·60
Solid matter	37·40
	1000·00

"The solid constituents were:

"Urea	10·0
Uric acid	0·41
Extractive	14·59
Alkaline chlorides . .	4·34
,, sulphates . .	3·12
,, phosphates . .	2·93
Earthy phosphates . .	1·99

"If we reduce these proportions to per-centage numbers, and compare with the per-centage composition of the constituents of healthy urine, they will stand thus:

	Per cent. composition of solid matter in this case.		Per cent. composition of solid matter in healthy urine.
"Urea . . .	26·80	..	44·50
Uric acid .	1·10	..	1·50
Extractive .	39·01	..	24·20
Alkaline chlorides .	11·60	..	10·25
,, sulphates .	8·34	..	12·35
,, phosphates .	7·83	..	5·40
Earthy phosphates .	5·32	.	1·80
	100·00		100·00

"From which you will perceive that the phosphates and extractive are greatly in excess of the normal proportion. As the urine was alkaline, it is very probable that the urea had decomposed, and was therefore in much larger quantity in the fresh urine. "H. L."

In reference to this last remark of Dr. Letheby, I may observe that in an analysis of the same urine made by myself whilst fresh, I found a larger proportion of urea than in any other sample of urine I had ever examined. The nearest approach was given by the urine of a patient suffering from acute rheumatism. The quantity of urea, determined by the volumetric method, was ·9 grain in thirty grains of urine. I also found the specific gravity to be higher than it was ascertained to be when Dr. Letheby examined the urine. The proportion of urea should stand at 29·7 per 1000 parts of urine, instead of 10.

Dr. Letheby was kind enough to analyse two more samples of urine which were passed on the afternoon of the 11th and the morning of the 12th of January, 1861. His report is as follows:—"The last two samples of urine contain, as you state, very small quantities of sugar. The other properties are—

	11th January.	12th January.
"Colour	pale amber	pale amber.
Deposit	white, and but little	white, and more.
Reaction	slightly alkaline	more alkaline.
	traces of sugar	traces of sugar.
Sp. gr.	1024	1014
Solid matter, per 1000	38·4	21·4

	Per-centage composition of the solid matters.	
"Urea	51·7 ..	53·8
Uric acid, sugar, and extractives	25·1 ..	18·8
Alkaline chlorides, sulphates, and phosphates	21·2 ..	24·6
Earthy phosphates	2 0 ..	2·8
	100·0	100·0

(For the twenty-four hours the means of these two analyses must be taken.—R. B.)

"The deposit, as in the last case, consisted of triple phosphates and oxalate of lime.

"H. L."

The total quantity voided in twenty-four hours was three pints and a half.

On the 12th of July, 1861, when it was considered that the disease was fairly arrested, I procured another sample of urine, which Dr. Letheby analysed. It gave—

"Colour . . .	pale amber.
Reaction . . .	faintly alkaline.
Sp. gr. . . .	1014.
1000 grains evaporated .	24·5 of solid matter.
Of the solid matter . .	7·0 was saline.
Of the saline matter . .	3·2 consisted of phosphates."

(The proportion of urea was 17 per 1000.—R. B.)

There were traces of albumen and sugar. The total quantity passed in twenty-four hours was two tenths of a gallon.

In a sample of urine passed on the 1st of December, 1860, I found 30·5 per 1000 of urea. The deposit, after two days' standing, showed very numerous epithelial scales, both of the columnar and tesselated varieties, and also sporules of the sugar-fungus, crystals of uric acid, and oxalate of lime. No albumen.

The characters of the urine may be briefly summed up as follows. During the active stage of the disease it contained a large excess of urea, of alkaline and earthy phosphates, and of extractive. It also almost constantly contained small quantities of sugar.

It is a matter of regret that more frequent examinations were not made.

The establishment of a form or stage of the disease characterised by the preservation of a yielding condition of the pelvic bones is one of very great interest. The question whether, in a given case, resort must of necessity be had to the Cæsarean section, or whether relief may not be obtained by some less formidable operation, may depend upon it.

This question is fully discussed in Kilian's work. He cites several cases in which the compressed pelvis could be opened out, either by the hand of the practitioner or by the child *in transitu*. One case is so striking that I hope I shall be excused for quoting it in some detail. It is contained in a letter which Kilian received in 1856 from Ed. von Siebold, who says—"I can only comply with your wish *obiter*, for the two accoucheurs concerned are dead. Tr— had long been burning with desire to perform the Cæsarean section. At length he thought he had a suitable case—a woman afflicted with osteo-malacia. He invited his colleagues (not me) to the operation, the deceased Os— with others. The woman already lay on the operating-table, when Os— begged permission to make another examination. He made it, and gradually passed in his whole hand, forcing the soft pelvic bones apart, turned the child, and brought it through living. This was on a Saturday; and he came to me early on the Sunday, and with tears of joy in his eyes told me— 'Yesterday I saved a woman from the Cæsarean section, and also from death.'"

Kilian extracts the following case from J. P. Weidmann's work 'De Forcipe Obstetricio,' 1813. The hand was passed through into the pelvis more easily than was expected, the feet of a dead child were seized, and the child was delivered without extraordinary difficulty. The mother died on the fifth day. The vagina was found in its posterior wall much mortified and the pelvis so misshapen and contracted that it was incomprehensible how the hand could have penetrated, and how the child could have been extracted.

Another case is taken from Von Ritgen, 1831. The wife of a surgeon, who, from much sitting and reading had a nervous fever, resulting in osteo-malacia. Von Ritgen, examining her when pregnant, found that it was possible by strong pressure to force the tubera ischii apart considerably. He brought on labour at the thirty-fourth week. The head of the child opened the outlet of the pelvis to a great extent, but this opening was not preserved afterwards.

The oldest case of this kind is that of John Welchman.

"The case of a woman who underwent the section of the symphysis pubis" ('London Medical Journal,' 1790). When the section was made, one pain drove down the nates, and another completed the delivery.

Another case is one of Mr. Barlow's, quoted by Dr. Hall. In 1794 a woman living in the deepest poverty was delivered by turning. During extraction Barlow observed that the pelvic bones opened, making room for the fœtus.

H. G. Spengel[1] relates a case. A pluripara, with the bones highly contracted, had a dead child weighing six pounds and a half, extracted by Naegele's forceps, the bones yielding manifestly. In a subsequent delivery she was delivered by the feet, the head being afterwards perforated. Some yielding of the pelvic bones was again noticed. In a later labour the bones were more consolidated. The Cæsarean section was resorted to; the patient died five days afterwards. Spengel relates another case of a pluripara, in whom dilatation of the bones took place.

Litzmann's memoir, already quoted, contains a similar case. In one labour the feet presented; the labour was difficult; it was supposed that the fœtus expanded. Pregnant again, the Cæsarean section was performed, and death followed in four days.

Dr. Breslau, in the case already referred to, says that during pregnancy it was difficult to pass the finger, but forcing in two fingers the joint pressure easily pushed the pubic bones asunder.

Dr. Tyler Smith also[2] adverting to the uses of the air-pessary, says—"I have also used the air-pessary before the time of labour, in a case of high deformity of the pelvis from mollities ossium, with considerable effect in separating the contracted bones. The case I refer to I saw with Dr. S. W. J. Merriman, and before the use of the pessary the tuberosities of the ischia were so close as scarcely to admit

[1] 'Diss. inaug. med. sistens dilatationem pelvis ex osteo-malacia coarctatæ in partu bis observatam,' Heidelberg, 1842.

[2] 'Medico-Chirurgical Transactions,' vol. xli, p. 191.

the passage of one finger. After the separation of the bones delivery was effected by turning."

A conjecture may arise that the dilatability of the osteo-malacic pelvis may be increased during pregnancy, and especially about the period of labour. At this time the disease itself has often been observed to commence, to be renewed after remissions, and to be rapidly aggravated in intensity. This consideration invests the conjecture I have started with some probability. The case of Breslau proves that even in early pregnancy this dilatability may exist. I can adduce no evidence bearing upon this point from my own case. The patient fortunately was not pregnant, and I did not feel it justifiable to use any violence without further motive than that of curiosity to ascertain the dilatability of the pelvis.

The question of treatment is one that will appear to demand the more attention, if we are open to the evidence in favour of the curability of the disease. This point is contested by some. Thus, H. F. Kilian[1] says—"That osteo-malacia *heals* is beyond dispute, but whether it is ever *cured* is altogether doubtful, for it is proved by the clearest evidence that in numerous cases osteo-malacia, without any aid from art, has arrived at complete arrest, and afterwards to fundamental healing. On the other hand, there is not a single fact that proves a particular method of cure, and this alone or even chiefly, has had a curative effect."

Upon this absolute conclusion the first remark to be made is that Kilian calls in question the accuracy of the diagnosis in the cases reported as cured.

The conditions laid down by him as necessary to justify a diagnosis of osteo-malacia are excessively rigorous. He only regards "that as the true osteo-malacia of adult women, which proceeds from the pelvis, or which is, at least, in early succession concentrated upon this part." For him, whensoever this does not happen, "the case wants its diagnostic signature and the essential of its existence." He disputes

[1] 'Das halisteretische Becken in seiner Weichheit und Dehnbarkeit nährend der Geburt erläutert,' Bonn, 1857.

the title of the case recorded in the 'Medico-Chirurgical Transactions' by the late Dr. Macintyre. As this case was seen by several Fellows of the Society, of whom I may mention Dr. Bence Jones and Dr. Watson, it will probably be concluded that the accuracy of Dr. Macintyre's diagnosis is not shaken, and that hence Kilian's definition is too arbitrary.

Not unconscious of the difficulty that so continually meets us in practice in assigning the respective measures of curative influence due to nature and to agents known and unknown, and to our remedies, where all are acting simultaneously, I think there is sufficient evidence to show that medical treatment has exercised a marked beneficial effect in some cases of osteo-malacia. Indeed, it may be justly argued from the admission of Kilian that since the disease sometimes remits and disappears, there are certain circumstances or certain agents that exercise a healing power. The physician surely need not despair of being able to trace out those circumstances and agents. And if he succeed, even partially, he may at once transfer at least a portion of those agents from the unknown or accidental to the available class of remedies. Arrived at this point, it may be fairly said that medicine has acquired a certain control over osteo-malacia.

The disease in its advanced stage—and it seldom comes under intelligent medical care at the commencement—is, no doubt, very formidable and intractable.

The history of the case now submitted to the Society may possibly not be considered complete. It may still be apprehended that the disease may reappear. But a complete remission of several months' duration, during which the patient describes herself as enjoying perfect health, may at least be taken as a temporary cure. In estimating the influence of treatment, I think a high place must be assigned to the cod-liver oil. There was no perceptible improvement in the patient's condition until she began to take this remedy. From that time her improvement was almost uninterrupted.

I have already mentioned that the use of cod-liver oil

was suggested to me by a case of Dr. Breslau. As it must be useful to adduce corroborative testimony of the effect of this remedy, I will cite briefly those cases in which it has been reported as beneficial.

Dr. Breslau's case.—Mrs. V—, near Zurich, æt. 42; never scrofulous or rhachitic; married at twenty-one; had three abortions during the first three years; living in poverty; then had two children at term; then one delivered by turning. Her health began to fail rapidly after a miscarriage, attended by severe hæmorrhage, a year ago. A dull pain affected the spinal column. She became pregnant in April. In November the spine and pelvis were much affected. The pulse was seldom below 100; clammy sweats; the slightest movement was attended with pain. The urine had a sp. gr. of 1005; it was free from albumen and sediment; phosphates were not increased; reaction acid. Induction of labour was decided upon, but labour set in spontaneously on the 12th of November. A dead child, weighing two pounds and a half, was expelled. The patient began to complain greatly of pain in her bones; cough, attended by profuse discharge from the lungs; and a low febrile state. She took large doses of cod-liver oil, Seltzer water and expectorants. On the 15th of January she had so recovered that the pains in the bones had ceased, the cough was better, and she had gained strength.

Dr. Litzmann[1] also relates a case which, he says, recovered tediously under cod-liver oil, good food, and Bavarian beer. Becoming again pregnant, she died in consequence of a Cæsarean operation.

[1] Opus citatum.

ON SOME AFFECTIONS

OF THE

CÆCAL PORTION OF THE INTESTINES.

WITH ILLUSTRATIVE CASES.

BY

FREDERICK GEORGE REED, M.D., M.R.C.P.

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The interest which usually attaches to diseases occurring within the cavity of the abdomen induces me to think that the relation of a few cases illustrative of one form of disease, of not very infrequent occurrence, will, in some degree, be conducive to the objects of the Society, and, under that impression, I beg to present them to the notice of its Fellows, with a few prefatory observations.

In speaking, generally, of the diseases of the intestinal tube, we recognise two conditions—the one, resulting from an excessive accumulation of intestinal contents or the impaction of foreign substances, at some particular part of its course, as its primary cause; the other, as commencing in the structure of the intestine itself, apparently independent of any accumulation or lodgment; and to these I might add a third, as resulting either from visceral displacements, or from formations that take place exterior to the intestinal tunics, but occasionally influencing the diameter of its canal and its functions.

These several conditions may lead to very similar consequences, so that in the progress of a case there may be an

occasional difficulty in deciding upon which of the conditions mentioned the existing symptoms depend. It is, however, usually otherwise, and the symptoms which present themselves, if considered both with regard to the manner and rapidity of their development, render their recognition not very difficult, particularly with respect to the two conditions first mentioned.

The four subjoined cases, I presume, may be considered as referable to the first-named condition, viz., "to accumulation or lodgment of the intestinal contents in the cæcum and commencement of the colon;" for circumstances sufficiently conclusive are mentioned in the relation of each, to raise the strongest presumption of the correctness of this view. Now, as this condition is the most favorable for securing relief to the patient by proper treatment in its early stages, it becomes a matter of extreme importance to have the means of recognising it before it has passed into its more severe and dangerous stages.

Having this in view, it may be stated, generally, that the symptoms in these conditions are not infrequently (indeed, it is probable, are most frequently) developed with greater rapidity and partake less of a chronic character than in *obstructions* resulting from changes in the structure of the intestine itself; and although the observation may be of little practical value, it should not be lost sight of, either in the diagnosis or in the treatment of these cases. The symptoms, however, which are of real value in determining the diagnosis of these cases are of a local character, and are the direct consequences of the accumulation within the intestine. As might be anticipated, there is a local tumour, dull on percussion, as the result of excessive accumulation, varying in size and form, and which some of the cases show is *well defined*, and is better examined whilst the patient is recumbent on the back, with the knees bent. This tumour is more or less painful on being firmly pressed with the hand, and as the symptoms advance the pain extends to the neighbouring parts of the abdomen, and eventually the whole abdominal cavity may become involved.

It should be borne in mind that the existence of local pain without the coexistence of other symptoms is insufficient for the object in view, for in obstructions of intestine which occur so frequently on the left iliac region, in the sigmoid flexure of the colon, the pain is often referred to the right side and to the region of the cæcum, and frequently also to the umbilicus. The pain, when referable to this cause, is, however, not aggravated to any great extent by pressure, neither does it radiate from the cæcum over the abdomen, as from a centre.

Taking these symptoms in connexion with those circumstances (which, probably, may be elicited by inquiry) with respect to the taking of indigestible substances into the stomach at no distant period of time antecedent to the symptoms, and having ascertained the previous habit and condition of the patient (particularly is this necessary in gouty or asthenic cases, from the liability in these subjects to attacks of colic) and specially in relation to the imperfect mastication of food, habitual constipation, or the passage of dry, hardened fæces from time to time, there will generally be no great difficulty in arriving at a just conclusion as to the nature of any case of a similar kind to the subjoined; and having done so, the proper general treatment to be pursued for the relief of the patient becomes a question of easy solution. It must be borne in mind, however, that the intensity of symptoms becomes greatly varied as cases of this kind proceed in their course, leading from those of simple distension of the intestine to the severest forms of inflammation and its consequences. The treatment which would be suitable for the first state would not be suitable for the other states.

Thus, in the early stage, when distension only exists, the obvious remedy is to unload the distended part by some means, and if this be done effectually the impending inflammatory stage is not developed. This would appear to be most certainly accomplished by the use of the hot-water hip-bath, followed by fomentations, and large emollient cataplasms applied over the abdomen, and also by injections

per anum of warm water or medicated injections, according to the features of each case, accompanied by the administration of such medicines as are known to stimulate the action of that part of the intestine in which accumulation occurs; and, perhaps, the most suitable medicine for this purpose is that preparation of aloes known as its "watery extract," administered in small and frequently repeated doses, in the form of pills, with soap (for an adult, one-grain doses of the extract with two or three grains of soap), given every hour, and, under certain circumstances, it may be combined with calomel, or, in asthenic cases, with the extract of nux vomica, if not contra-indicated. Should there be nausea or the stomach be irritable, frequently repeated doses of saline effervescing medicines, with an excess of alkali, may also be given with advantage. When, however, a case has passed into its inflammatory stages there should be a corresponding change of treatment, or, rather, an addition to the former-named treatment, suitable to the relief of inflammation, as detailed in the cases brought by me under the notice of the Society. Again, the inflammation may lead to its usual consequences, provided the patient does not sink directly under its influence.

These consequences are well illustrated by the following cases. In the first, the patient did not survive the inflammatory stage. In the second, an abscess was established, and a fistulous opening of communication with the intestine formed, but it fortunately closed at a subsequent period under a treatment recommended by Sir Benjamin Brodie. In the third, mortification of the intestine occurred to a very great extent, and most remarkable powers of reparation and recovery were brought into play.

It would be misplaced whilst offering these observations to the Fellows of this Society, for me to enter either upon the remarkable anatomical formation of the cæcum, with its occasional variations, its peculiar physiological functions, or upon the diagnostic signs of the several abnormal conditions with which accumulation or lodgment, followed by obstruction in the cæcal portion of the intestinal canal, may possibly be

confounded, and which render the special affections of this viscus peculiarly interesting.

I trust, in the narration of the accompanying cases, many of the prominent practical points are sufficiently indicated, without unnecessary prolixity.

Case 1.—On 13th August, 1858, Mr. Nowell Stowers, of Newington Place, Kennington, was requested to see A. B—, æt. 18, the son of a gentleman residing at Brixton, Surrey, who previously had enjoyed perfect health without any exception. He was short in stature, of a sanguine temperament, and of a robust and strong constitution.

Mr. Stowers stated that he found him suffering intense pain in the abdomen, of a colicky nature, and with tenderness on pressure in the right inguinal region; his skin was hot, his pulse quick and full, and tongue furred. He had no sickness.

He had been in his usual good health, and taking daily active horse-exercise, up to two days previously, when he had eaten a considerable number of unripe plums and largely of lobster salad. During the course of the same night and following morning, feeling, as he stated, "uncomfortable in his interior," and his bowels being constipated, he took a table-spoonful of castor oil, which he repeated after a time. As neither of these produced any effect, he procured from a chemist in the neighbourhood, and took, a calomel pill and black draught. These produced a very violent effect, acting twenty times at least, attended by violent tenesmus, dislodging a large fæcal accumulation and a great many plum-stones.

Each evacuation was attended by considerable pain in the abdomen, and was followed by great feeling of exhaustion.

The pain in the bowels having increased, contrary to his expectations, Mr. Stowers was sent for. He immediately prescribed leeches to the right side of the abdomen, to be followed by warm fomentations, and also small doses of calomel and opium, and carminative and astringent medicines, to relieve the diarrhœa and tenesmus.

I was requested on the evening of the 14th August to see him, in consultation with Mr. Stowers.

On my arrival I found the patient was suffering great and constant pain, extending over the whole of the abdomen, which was increased on deep pressure, but especially felt in the right iliac and inguinal region, extending into the right hypogastric and the umbilical regions. There was a distinctly defined swelling, about the size of a small orange, in the situation of the cæcum. It was dull on percussion, and the pain was most intense in this part on coughing, deep inspiration, and on extending the right thigh. There was not any sickness. His pulse was hard, and 96 in the minute; his skin hot, but not remarkably so. His countenance had rather an anxious expression. His tongue was covered by a yellow coating, and its edges were rather dry. There was thirst, but not excessive. The breathing was thoracic, the urine turbid, and loaded with lithates, sufficient in quantity, and free from albumen. He had constant tenesmus, voiding only small quantities of mucus, tinged with blood.

He was ordered leeches to the right iliac region, one grain of calomel, and one third grain of opium every hour; turpentine stupe, succeeded by linseed poultices, to be applied to the whole of the right side of the abdomen; an opiate suppository, and perfect rest and farinaceous diet; *and all solids were prohibited.*

On the following and subsequent three days there was but little or no alteration or improvement in his general symptoms; but the tumefaction in the right iliac region increased considerably in size, though not in tenderness; neither were the symptoms of general peritonitis more decided.

I saw our patient twice daily in consultation with Mr. Stowers, and the same plan was continued, but the doses of calomel and opium were more frequently administered. On the 18th a peculiar fœtor in his breath was noticed; his countenance became more anxious, and he became more feeble, and he had occasional hiccup, and some tympanitis existed; his bowels acted frequently and involuntarily, with

small quantities of liquid muco-feculent evacuation, tinged with blood, and very offensive.

His pulse became soft, weak, and compressible; his voice feeble; there was still total absence of nausea, eructation, or sickness; his skin was cold, moist, and clammy; there was no shivering, and no increase or remarkable diminution of pain, and no head symptoms; but the aspect of the case could not be well more unpromising.

The gums showed evidence of slight mercurial action, the calomel therefore was forthwith discontinued, and he was ordered increased quantities of strong animal broths and port wine, &c.

On the 19th the evidence of mercurial action was more fully marked, and *from this date his symptoms gradually diminished in intensity*, and his strength appeared to improve, but a tender and solid swelling, of about four inches in circumference, which had become distinctly circumscribed, remained on the right side of the abdomen, principally in the right iliac and inguinal regions.

Occasional doses of grey powder, with a view to maintain its action, were subsequently administered. Blisters, iodine, and mercurial ointments were applied locally. He was directed to take plenty of liquid, animal, and farinaceous nourishment, with wine daily, *but no solids of any kind.* Under this treatment his improvement continued gradual and satisfactory up to the 2nd September (three weeks from the commencement of his illness). At this time the general abdominal tenderness had nearly disappeared, but the hardness and fulness of the cæcal region continued, with slight tenderness in the part, and a sensation of internal soreness, though the swelling had considerably diminished in size.

The diarrhœa and tenesmus which continued were kept in check by opiate suppositories and acetate of lead, sulphate of copper, and gallic acid, which, from time to time, were administered internally up to the 2nd of September. On this day he was so well that he was allowed to sit up in a chair for a short time. Late in the evening of this day

the nurse discovered, after an action of his bowels, that he had passed something extraordinary, but without his personal knowledge, or causing him any unusual sensation. Mr. Stowers was immediately sent for, and on examination he found it *apparently* to be a portion of intestine, ten to twelve inches in length, surrounded by a large quantity of dark matter, with portions of fæcal matter adherent, and mixed with blood and mucus voided at the same time.

The patient was forthwith ordered to bed again, to be kept quiet, and in a recumbent position, and to avoid all exertion, especially straining or making any effort at stool. The bowels became, however, very irritable, and he passed frequently liquid fæcal motions, mixed with dark, bloody mucus; this symptom was treated by opiates and astringents, and he was restricted still to animal broths, with rice, arrow-root, &c. After this he continued to improve generally, without any remarkable new symptom up to the 10th October, when he was so well that we deemed it advisable he should go to Brighton for sea air.

While there, he had strict injunctions to continue the same diet, and to avoid *all solid food for some weeks*, and gradually to take an increase of exercise. He was also ordered to take the tincture of sesquichloride of iron in ten to twenty minim doses, two or three times a day, and to keep the diarrhœa under control by occasional doses of acetate of lead, or gallic acid with opium, and to take a dose of castor oil if the bowels were not satisfactorily acted upon daily. This constituted his treatment for three or four weeks, after which time he was permitted very gradually to return to his ordinary diet and habits; and, except suffering from occasional looseness in the bowels, and pain (on any over exertion) in the right iliac region, he continued to improve for several months, until all uncomfortable sensations disappeared, and he felt quite well.

He has for the last eighteen months been, and is at the present date, (December, 1861), after the lapse of more than three years from the commencement of his illness, in perfect

health in every respect, with no perceptible alteration in any function or sensation.

Accompanying this paper, is the mass voided, which was given to my late friend Mr. Quekett, for the museum of the Royal College of Surgeons. Mr. Quekett kindly examined it minutely with much care and interest, and the following is his report upon the subject:

"I find that the preparation submitted to me, consists of portions of the intestinal canal, the parts best marked being the cæcum and appendix vermiformis. As now mounted, the mucous membrane of the cæcum may be seen at the upper part, and that of the appendix at the lower part of the preparation.

"When examined microscopically, both these structures exhibit the follicles of Lieberkühn, and the absence of villi. The muscular, and also the peritoneal coats, are very apparent in some parts, and agree in all respects with those of ordinary healthy specimens of these tissues. The length of the specimen, as it is now mounted, is between nine and ten inches; and I should consider it a portion of the large intestine, with cæcum and appendix vermiformis. Of the former, only about *one third* of the *calibre of the canal*, whilst of the *latter* the *entire tube was present*. We have nothing of the kind in the museum of the College of Surgeons, and this circumstance alone would induce me to believe the occurrence was one of considerable rarity."

Instances of recovery, after portions of the intestinal canal have been passed per anum, with the *cylinder entire*, have been recorded; but peculiar interest is attached to the present case, as I think it may be assumed (after careful examination of the preparation exhibited) that intussusception did not exist, but that, from the enteric inflammation and its results (originating in the cæcum), it is not improbable that the anterior surface of the large intestine voided became agglutinated to the peritoneal surface of the abdominal parietes, and that the portion, or "section" it might be termed, of the intestinal tube, with the cæcum and

appendix vermiformis, were thrown off by ulceration, and subsequently passed per anum; the void having been repaired, and the continuity of the canal maintained by the adaptation of the effused lymph to the parietes of the abdomen, the adhesions formed having also prevented the escape of any of the contents of the bowels into the peritoneal cavity.

Case 2.—On the 13th April, 1846, I was requested to see A. T—, æt. 14, a fine, tall, well-developed girl. I learnt at my first visit she had been seized *suddenly* with pain in her abdomen the day preceding. Her bowels having been constipated for some days previously, she had in consequence taken several pills and other aperient medicine, which, however, had produced no action of the bowels up to the time of my seeing her, but the pain was stated to have gradually increased. She had not previously eaten anything unusual, neither could the attack satisfactorily be accounted for, but was supposed to arise from cold.

I found the abdomen rather distended, and she complained of pain on slight pressure, increased on doing so firmly. It appeared to be most severe in the right iliac fossa, but I could detect only a slight fulness, but no hardness or dulness in that situation. She had a feeling of nausea, but had not vomited. Her skin was cool and moist, her pulse sixty-five in the minute, small, and compressible. There was no hernia. Her countenance was rather anxious, and she said "her feelings of illness told her she should die." I ascertained she was a nervous, sensitive girl when she did not feel well, and was very hysterical, which circumstance rather obscured the diagnosis. I ordered her a warm hip-bath, followed by warm linseed poultices to the right iliac region, a full dose of calomel and opium, and a turpentine enema.

The day following I found the bowels had acted twice after the injection. The evacuations were stated to have been healthy and fæcal, though hard and constipated; but the pain in the abdomen had considerably increased, especially in the right iliac fossa, where a distinct fulness, about three

inches in extent, dull on percussion, was distinguishable. She had vomited several times, and I entertained no doubt that inflammation existed. Leeches were applied, followed by a turpentine stupe and half a grain of calomel, and one eighth grain of opium, was ordered to be taken every hour, and fluid nourishment only, and quietude.

The next day the local pain had increased, but not the swelling; all her general symptoms had become more severe, tympanitis existed, and there was continued vomiting. There had been no action of the bowels since the effect of the first turpentine injection.

On the morning of the 4th day she appeared approaching a state of collapse. I directed the calomel and opium which had been given up to this time to be discontinued, and brandy and wine, with soda water, to be given ad libitum.

On the morning of the 5th day she expressed herself as much easier, and "thought something had given away in her bowels, which was the cause of her relief," but she appeared in a sinking state. There was much less fulness in the right iliac region, and less abdominal tenderness.

The day following (the 6th), I found she had rallied considerably, and that she had been able to take stimulants and nourishment, but diarrhœa had set in, offensive liquid fæcal matter passing continually, mixed with blood and mucus.

This continued for three or four days, being only partially checked by various astringents with opium. The vomiting having, however, ceased, she was able to take nourishment and stimulants, and her strength improved.

On the 11th day a solid mass passed from her bowels without causing her any pain or discomfort, which I found on examination to be six or seven inches of intestine, in a gangrenous state (apparently large intestine). I ascertained that the calibre of the canal was complete, and it was surrounded by some dark bloody mucus. She continued to improve from this date, but suffered from diarrhœa and dysenteric symptoms for five or six weeks, attacks of which became, on two or three occasions, so severe, and lasted from twenty-four to thirty-six hours, producing so much

depression and exhaustion that it appeared probable she would sink from this cause.

Lead, bismuth, and many mineral and vegetable astringent medicines combined with opium, were prescribed, but sulphate of copper appeared to be the only medicine that exerted any lasting beneficial influence. It was given in doses of one twelfth of a grain, with one eighth of a grain of opium, in the form of pills, every three hours, for three or four consecutive days, when the dysenteric symptoms had nearly ceased. The diarrhœa recurred from time to time, but was always controlled by a few doses of the same medicine. She was restricted to *fluid nourishment only*, until about the expiration of two months from her first seizure, when all symptoms of her illness had disappeared, and she returned to her former habits.

She continued quite well, only suffering from hysteria and habitual constipation for seven or eight years subsequently, and is alive and well at the present time (December, 1861).

The morbid specimen was unfortunately thrown away by one of her family, after I had placed it aside for preservation.

Case 3.—A. B., æt. 20, a stable groom, a very healthy young man, strong, robust, active, and of sanguine temperament.

Arose from his bed at 5 a.m., feeling quite well. Shortly afterwards he ate hastily three or four good-sized apples, not fully ripe. He subsequently performed his accustomed stable work and rode a saddle horse for exercise for an hour.

At 8 a.m. of the same day, he made a hearty breakfast of meat.

At 9.30 a.m., whilst grooming a horse, he was suddenly seized with intense pain in the right iliac region, which obliged him to go to his bed. He was advised and took a dose of castor oil, and, subsequently, some tincture of rhubarb, which acted two or three times freely it was stated.

I was requested by his master to see him a few hours afterwards. He was lying on his back, with his right thigh bent, and complained of severe pain in the right iliac fossa, in the situation of the cæcum, extending in the direction of the ascending colon. There was no general peritoneal tenderness or any local tumour or swelling, but the pain was much increased on firm pressure. He had vomited several times, and it was stated that the breakfast he had eaten had returned, and he said "he felt convinced some hard apples he had stuck there" and that he could put his finger on the most painful spot in the right iliac region. His bowels had acted freely two hours before I saw him. There was no hernia. His countenance and manner were very anxious and troubled; his skin was moist and clammy; his pulse quick and full.

I ordered him a warm hip-bath, to be bled to fourteen ounces, twenty leeches to be applied to the painful part, succeeded by warm emollient poultices. A full dose of opium to be taken directly, and followed every hour by one-grain doses of calomel and one third of a grain of opium; no further aperient to be given, and fluid nourishment only.

Late in the evening of the same day I found diffused peritonitis had set in. A turpentine stupe was applied externally over the whole of the right side of the abdomen, and a gruel injection with turpentine was ordered, which was followed by two healthy fæcal evacuations from the bowels, and produced some feeling of relief.

On the 3rd (the following day), in the morning, his inflammatory symptoms had become more severe. Tympanitis had come on, and the pain occurred in paroxysms, and he appeared to suffer great agony. Opiates in full doses gave only slight relief. Vomiting occurred occasionally, but there was no fæcal smell in the matters ejected. Nothing further had passed from the bowels.

The calomel and opium and other measures were ordered to be continued. On the night of the third day the symp-

toms of collapse appeared, and he sank early in the morning of the fourth day.

On inspection the following day, the peritoneal cavity was full of bloody serum, with flakes of lymph. The convolutions of the small intestines were all highly gorged and glued together, in many parts, by recent adhesive matter, and they were also distended with gas, and contained a considerable quantity of pulpy matter.

The cæcum (which appeared to have been loosely connected congenitally by peritoneum to the right iliac fossa) together with the appendix vermiformis and about four inches of intestine which I took to be ileum, thickened and surrounded with masses of bloody lymph, were invaginated within the ascending colon, and appeared in a partial state of sphacelus. On carefully examining the interior of the cæcum, a portion of the core of an apple, about one third of an inch in diameter, was entangled, and appeared stuck in the free edges of the cæcal portion of the ileo-colic valve, and required some slight effort to remove it with forceps from its bed. All the structures of the transverse and descending colon were much thickened and surrounded by dark coloured lymph from inflammatory action. The stomach and duodenum and rectum were healthy.

Having promised his relatives that no portion of the abdominal contents should be removed from the body, if a post-mortem examination was allowed, I was not permitted to bring away the very interesting morbid specimen. The case was seen by me in consultation with Dr. Furnival, who was also present at the post-mortem.

Case IV.—A lady, æt. 23, short in stature, of an unusually spare habit of body and leucophlegmatic temperament, and very fragile in appearance, but who had always enjoyed perfect health. Shortly after her marriage, in the latter part of the year 1848, became pregnant, not suffering more than the ordinary discomforts of that state. At the end of July, 1849, she was prematurely confined at the seventh

month, the child being in a state of putrefaction. The cause of this miscarriage was supposed to have been an accidental fall. She had considerable post-partum hæmorrhage, but she recovered without any other unfavorable symptom. She had, however, suffered from mental depression and debility consequent on the disappointment at not having a living child, and the loss of blood she had sustained. Otherwise she felt, and was considered by her friends to be in her usual good health, until the 16th or 17th of November in the same year; she was then suddenly seized with pains in her bowels. A medical gentleman residing in the neighbourhood being consulted, leeches were applied to the abdomen, and some laxative and sedative medicines were administered. I was requested to see her in the evening of the same day. The following was her condition at my first visit:

Her countenance was flushed, but *not anxious*. Her skin was hot and dry; her pulse was small, hard, and not readily compressed; her tongue was moist and flabby, with a slight yellow coating over the whole surface. She had great pain in her bowels, and was fearful about the result. She complained of nausea, and had retched several times, but had not vomited.

On putting my hand on the abdomen there was found to be a general tenderness, but the pain was most intense in the right iliac region, where there was considerable and diffused tumefaction, and a tumour about the size of the double fist of an ordinary man situated deep in the fossa, with a defined margin, and dulness on percussion was also detected. I satisfied myself there was no hernia. The abdomen generally appeared full, but not tympanitic. There was no nephritic pain or tenderness, but the urine was loaded with lithates.

On examination by the vagina, the tumour could with some difficulty be reached by the finger; it had a doughy feel, was round in form, and painful on pressure. I could, however, feel the right ovary distinctly, much larger than ordinary, but not tender; the uterus was natural and healthy. On close inquiry it was elicited that the bowels

had been very constipated for several days, and that for some time previously they had always acted scantily and with difficulty, and chiefly small hard lumps passing.

She thought her illness had "something to do with her confinement, and could not say how long the swelling had existed, as she had never noticed it."

I thought the tumefaction arose from some impaction in the cæcum and that enteric inflammation had been set up with diffused peritonitis; I accordingly ordered leeches to the right side, succeeded by turpentine stupe.

Calomel, gr. j, opium, gr. $\frac{1}{3}$, every hour. A large warm linseed poultice over the whole abdomen, and *exclusively fluid farinaceous diet.*

On the 18th (the day following) the pain had slightly diminished, her bowels had not acted. I ordered an enema, with turpentine and gruel, three pints at least, which acted three or four times, dislodging a considerable quantity of hardened feculent matter, and the previous treatment to be continued.

On the third day (19th), I was disappointed in finding that no improvement in the symptoms had taken place from the free action of the bowels. On the contrary, the swelling in the right iliac region had increased; the pain was more intense and diffused, extending into the right hypochondriac region. The patient could not bear any movement. The stomach had become irritable with constant nausea and retching, and she also complained of most intense pain in the right hip and dorsum of the ilium, extending down the thigh, leg, and foot, in the course of the anterior crural nerve.

I directed the same doses of calomel and opium to be given every half hour till the gums became affected; saline effervescing draughts, (with an excess of alkali) and hydrocyanic acid, every three or four hours, to allay the sickness; also croton oil, to be applied externally over the whole of the right side of the abdomen, and covered with warm poultices, and another large turpentine enema to be used, and repeated in three hours, if an action of the bowels did

not take place. The first produced two or three very offensive liquid fæcal evacuations.

From the 19th to the 23rd she continued in a variable though unsatisfactory state. Although all her symptoms were subdued in intensity, and the pain in the right side of the abdomen had become a much less prominent symptom, she was yet unable to bear any pressure or movement. The irritability of the stomach, however, had ceased, and she was able to take animal nourishment in a fluid state, and also by enemata, combined with starch. The calomel and opium were continued, though the quantity and intervals were varied, according to the daily, almost hourly, intensity of the pain and symptoms; and her strength was supported generally by nourishing diet in a fluid state. Her pulse varied in some degree; her tongue and her several symptoms presented no remarkable variation of interest worthy of being mentioned, except that the pain became more *localised* in the right iliac region; the swelling gradually increased, extending into the umbilical and right hypogastric region.

There was also increasing and most intense pain in the hip, dorsum of the ilium, and groin; also in the course of the anterior crural nerve of that side; and *the right thigh, leg, and foot, gradually became œdematous*, pitting deeply on pressure. In fact, the patient complained of this more than any other symptom, and continually exclaimed, "All her disease arose from her hip-joint." Opiates were administered internally in large doses, and belladonna with camphor applied externally with relief, and the whole limb was enveloped in wool.

On the 24th of November the mercury was entirely discontinued, and opiates in various doses and forms were given to relieve the pain in the hip and right leg.

On the 28th of November, Sir Charles Locock met me in consultation, and subsequently on the 3rd of December Dr. Robert Ferguson's assistance was also requested. An opinion was at first entertained that an enlarged ovary might have become inflamed, and thus pressing on a portion of the bowel, might have caused obstruction; but the exami-

nation by the vagina decided this not to be the case; the rectum was found to be quite empty, and the right side of the pelvis appeared blocked up with a large hard mass. It was determined to pursue the same plan of treatment, and to solicit the bowels to act by daily injections of warm gruel only.

From this date to the 7th of December no material alteration took place, except that the strength of the patient decreased, but her stomach remained quiet, and thus enabled her to take considerable quantities of strong animal broths, wine, brandy, &c.

From the 7th to the 10th, symptoms of collapse came on, with hiccup and occasional fits of shivering, and the swelling became externally much more prominent, followed, in a day or two, by redness and a tendency to point just above Poupart's ligament and mid space between the anterior inferior spinous process of the ileum and the linea alba.

She appeared to rally under the very large quantities of nourishment and stimulants she was able to take; and as she had not appeared to have any satisfactory relief from her *upper bowels for nearly three weeks*, a strong turpentine injection, combined with ox-gall, with warm gruel, in all upwards of two quarts, was carefully and gradually administered. This was followed, in half an hour, by an enormous discharge of nearly two chamber-potsful of the most offensive fæcal matter. Extreme prostration and threatened sinking followed, and continued for twenty-four hours more, and she appeared on the point of death, but she again rallied under the use of large quantities of brandy and ammonia.

Two days after this occurrence there was a great feeling of relief, and the tumour had diminished considerably; but fluctuation was now perceptible externally, and it became evident that an abscess had formed. The abdomen was soft, and of its natural size in other parts, and free from pain, but with slight tenderness on pressure.

The pain in the hip, leg, and foot *entirely disappeared*, and the swelling also subsided gradually from this time.

On the 20th of December, nearly five weeks from the

commencement, the abscess burst externally; ten or twelve ounces of most offensive, dark-coloured pus were discharged, and subsequently small portions of fæcal matter began to ooze out with the pus. Warm fomentations were used, and linseed poultices were applied externally. Two or three days following it was discovered that pus in considerable quantity, mixed with fæcal matter, passed from the bladder each time the patient voided urine, which was every hour or two.

The bowels became irritable; the patient exhausted and hectic; and her state fluctuated for two or three weeks; but, by the aid of nourishment, and the continuous use of stimulants, opiates, and tonic medicines, notwithstanding two to four ounces of pus passed daily from the wound, she gradually gained strength.

The communication with the bladder appeared to be healed spontaneously; the bowels acted healthily, though very scantily, with the aid of daily injections of warm water, no aperient medicine being given by the mouth; but a fæcal fistula became established where the abscess burst externally in the inguinal region, and, according to the excited or quiescent peristaltic movement of the bowels, fæcal matter passed constantly, varying in quantity though *daily much more considerable than that passed per anum.* The opening was about half an inch in length, oval in form, with slightly ulcerated, elevated, irritable-looking, and everted granular edges. A probe could be introduced three or four inches, and moved to and fro, apparently in the cavity of the cæcum. There was constantly a most offensive odour from the wound, and the matter passing was peculiarly offensive and sickening.

The patient appeared to have recovered her health generally, but any movement or exertion gave her great pain in the region of the cæcum. She had ceased to menstruate from the commencement of her illness up to this time.

On the 24th of June, 1851, seven or eight months from the attack, Sir Benjamin Brodie saw the case in consultation

with me, and was much interested with its details and nature.

He gave a doubtful prognosis as to complete recovery, but advised her having a couch made so as *to be recumbent on her face day and night for several months;* to have the edges of the wound touched occasionally with nitrate of silver, and to take 5j doses of powdered cubebs twice daily for some months, and of course to adopt all general measures for the improvement of her health, and the occasional use of injections per anum if necessary. The result proved most gratifying and successful. The patient most rigidly and faithfully maintained the position recommended both by day and by night, and after a few days stated "that instead of finding the position irksome, it afforded her such a feeling of local relief and also comfort from the diminution of the discharge, that she should be most unwilling to alter it until quite well." At the end of six months, the discharge ceased entirely and the wound was healed. For a few months subsequently the patient suffered occasional pain in the part, which was always relieved by the prone position. At the end of twelve months she was quite recovered, and has continued, and is at the present date (twelve years having elapsed) perfectly well, the only alteration being, that the bowels do not act without the habitual aid of some simple medicine.

APPENDIX.

Several questions having been put to me by members of the profession in relation to this interesting case, I have endeavoured, for the sake of conciseness, to comprise the most practical points under the three following forms of inquiry:

1st. Did the recovery from the fæcal fistula depend on the subsequent treatment adopted? and was it an instance of *post hoc propter hoc?*

2nd. Why was the prone position on the face recommended?

3rd. With what object were cubebs prescribed?

In explanation, I reply to the above *seriatim*—

1st. Quite recently, in conversation with Sir Benjamin Brodie on this subject, he told me that since the above case he has had another similar one of cæcal fistula under his care, in which precisely the same treatment recommended by him proved successful and curative.

2nd. In all those cases of rupture of the cæcum followed by abscess, which Sir Benjamin Brodie has had the opportunity of examining after death, on dissection, the opening has been uniformly at the posterior part of the intestine; consequently, the object of the patient, maintaining the prone position on the face, becomes obvious.

3rd. The use of powdered cubebs pepper was suggested from it having been found to be often very beneficial in cases of internal piles, and especially useful when the patient suffers from hæmorrhage in consequence. The powdered cubebs pepper seems to act by mixing with the fæces, and becoming a topical application to the mucous membrane of the bowel. In the case related by me, the grains of pepper were daily recognisable in the fæcal matter passing through the fistulous opening. The medicine appeared to be grateful to the stomach, and to aid the action of the bowels.

THE

POISONOUS EFFECTS OF COAL-GAS

UPON THE

ANIMAL SYSTEM.

BY

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I was induced to make the present inquiry in consequence of the examination of gas (as to its purity) now forming an important branch of my duties in the care of the public health. I also wished to ascertain whether cannel gas destroyed life sooner than common gas, since this question had arisen at a recent coroner's inquest. The third and fourth objects were to counteract, if possible, by publicity, the want of precaution often displayed by gas-fitters in the discharge of their duties, and to try means for their recovery when rendered insensible.

Mr. S. D. Broughton has published a very interesting inquiry on a similar subject in Brande's 'Journal of Science,' vol. xxix, but the gases which he employed were in a pure state.

The following are the results of some experiments made by myself, Mr. F. G. Evans, engineer of the Chartered Gas Company, and Mr. Henry Banister, assistant engineer, at the works in Horseferry Road, Westminster, November 8th, 1861.

A rat was first killed by means of a sharpened file thrust

into the brain, for the purpose of comparing the appearance of some of the internal organs with those of others destroyed by the gases. The eyelids were closed; the lungs collapsed, and of a whitish colour; both ventricles of the heart contained black coagulated blood.

I. *Experiment with cannel gas.*

A rat was placed under a bell-glass, six inches in diameter and ten high, into which cannel gas was passed through a three-eighths of an inch cock and tubing with half an inch bore. The animal soon began to gasp, and became insensible in twenty seconds after a slight struggle. It lay motionless for a few more seconds when convulsive movements were perceptible; death occurring in sixty-five seconds. The eyes were open and projected greatly. The outer surface of the skull was exceedingly red, not only in this but in the other animals which were examined, and dark fluid blood escaped from the heads when opened. The superficial vessels on the surface of the brain pinkish, and some empty; the substance of the brain pale. The lungs collapsed and of a pink colour; the heart distended with darkish fluid blood; congestion of the abdominal veins.

II. *Experiment with common gas.*

A rat was killed in the same way with common gas. It fell comatose in half a minute, without convulsion, and died in one minute and a half, after spasmodic action of the diaphragm. It lived longer than any other out of a total of twelve exposed to the action of the gases. The eyes open and projecting; the vessels of the brain and its substance as in the previous experiment; lungs collapsed and pinkish; heart and abdominal veins distended with dark fluid blood.

III. *Experiment with cannel gas.*

A rat having been exposed in the same way to the action of cannel gas became insensible in twenty-five seconds, and

died in one minute. A post-mortem examination revealed the same appearances as those previously described, excepting slight coagulation of the blood in the left ventricle of the heart.

IV. *Experiment with foul gas.*

A rat exposed to foul gas under the glass vessel became insensible in eleven seconds, without convulsion, and died in three quarters of a minute. The eyes closed at first and subsequently opened, but did not project so much as in the other examples. On opening the body a strong smell of sulphuretted hydrogen gas escaped. The brain and lungs were much congested, and of a brownish colour; the heart greatly distended with dark fluid blood, the auricles being nearly black; abdominal veins distended with dark blood.

V. and VI. *Experiments with common gas.*

Two more rats were compelled to breathe common gas, one of which became insensible in thirty-three seconds, and died in one minute and twenty-three seconds; the other became comatose in twenty-one seconds, and died in one minute and ten seconds. The post-mortem appearances were identical with those detected in the second experiment.

On November 6th, the author examined six rats killed at the works in the same manner as the last six just mentioned, all of which had died with their eyes open. The post-mortem appearances were similar, but no record had been taken of the experiments during the administration of the gases.

In remarking upon the physiological results of the experiments it may be observed that death ensued from the combined effect of different coal gases, the chief constituents of which are, after purification, light carburetted hydrogen, hydrogen, carbonic oxide, carbonic acid, oxygen, nitrogen, and the condensable hydro-carbons; whereas the foul gas contains, in addition, ammonia and sulphuretted hydrogen.

Again, cannel coal-gas contains more hydro-carbon vapours than common gas, for which reason it probably destroyed life more quickly than the common gas.

The cannel gas supplied by the Chartered Company is made with a mixture of Bog-head and Newcastle coal, while the common gas is made from Newcastle coal enriched with a small per-centage of Wigan cannel coal.

The impurities of common Newcastle coal-gas, according to Lewis Thompson,[1] may be taken at $\frac{1}{2}$ part of ammonia, 8 parts of sulphuretted hydrogen, and 25 parts of carbonic acid in every 1000 measures of the gas. Dr. R. D. Thomson[2] gives the following analysis of London gas; olefiant 3·86 per cent, carburetted hydrogen 38·93, hydrogen 46·43, vapour of water 2·48, carbonic acid ·46, carbonic oxide 5·62, nitrogen 2·22.

While testing the gases from the Chartered Company with Cooper's tube, which may be considered merely as an approximation to the truth, I have found that the common gas contained about 1 to 2 per cent. of carbonic acid, 4 to 5 per cent. of hydro-carbon vapours, $\frac{1}{2}$ to 2 per cent. of carbonic oxide, but the cannel gas contained of carbonic acid from 1 to $1\frac{1}{2}$ per cent., carbonic oxide ditto, hydro-carbon vapour 12 per cent.

On a post-mortem examination of five bodies of persons quoted by Mr. Taylor in his work on poisons, there was congestion of the brain and its membranes, the pia mater gorged with blood and the whole surface of the brain intensely red and the blood coagulated. In two other cases there was congestion of the brain, but the blood was remarkably liquid. The effects, however, produced by the coal-gas were owing to its long-continued respiration in a diluted state, which may account for their difference when compared with the results of the preceding experiments. In these the blood of only one rat was loosely coagulated in the left ventricle of the heart. The brains also of all, excepting that killed by the foul gas, were free from congestion.

[1] 'Chemistry of Gas-Lighting,' p. 34.

[2] 'Evidence on Gas (Metropolis) Bill,' 3523, June 29th, 1860.

Mr. William Bloxam, junior, has kindly favoured me with the following notes of a case of poisoning by coal gas:

"On November 21st, 1861, at about three o'clock p.m. I was hastily summoned to No. 20, Mount Street, where I found the deceased, William Dunkley, supported in a sitting posture upon the shop floor; the surface of the body being cool, cornea glazed, face pale and placid, some froth in the mouth, pupil rather dilated, limbs supple.

"The premises smelt strongly of gas; and I suggested the desirability of stopping the further escape of gas and occurrence of accident, by plugging the pipe with clay, and as the sewers of the street were under repair, clay was at once obtained and used.

"I carefully examined the scene of accident, and in order to reach it, had to pass through a large workshop on the basement, which was so full of gas that I had to stoop very low, in order to breathe freely.

"In a narrow area, and at one end of it, was a small closet which appeared to have been formerly a larder. The door was open, but there being a fanlight over the door, an atmosphere of gas yet remained in the upper part of the closet.

"Tools lay on a shelf at the top; and I am told that the deceased was found on the top of a pair of steps in the closet, in a sitting posture, his head on one side, arms hanging down, and back leaning against the wall. He was connecting a meter.

"It is worthy of remark that he did not appear to have even attempted to descend from the steps.

"*Autopsy twenty-four hours after finding the body.*—External appearance—Face and upper part of body pale, no marks of violence; rigor mortis well marked; sugillation on whole of back of body and limbs. General appearance that of a somewhat feeble man. Blood everywhere fluid. Brain and membranes by no means congested, rather pale than otherwise. Lateral ventricles contained much pale serum. No coagulation in corpus striatum, optic thalamus,

crus cerebri, cerebellum, nor other position; brain and cerebellum apparently healthy. *A powerful odour of gas* on opening cranium and slicing brain down to corpus callosum. Lungs did not collapse on raising sternum and cartilages; were dark-red; darker at back of lobes, from gravitation of blood. Tissue healthy. Trachea and bronchi contained frothy mucus in some quantity. On securing a bronchus, removing lung, and collapsing by pressure, *a very strong odour of gas was perceived.* Right side of heart disturbed, left nearly empty. Blood black everywhere. Heart healthy. No signs of irritation or disease in abdominal viscera; congestion of abdominal system.

"The deceased was last seen alive an hour prior to the detection of the accident, and it seems reasonable to suppose that he died from the narcotic effect of the rapid inhalation of the gas. If asphyxiated, he would probably have made an attempt to get down; but there was, it seems, enough air to sustain life while the narcotic element was gaining upon him."

I cannot help believing that the deceased committed an error of judgment, which is too frequently the case, while adjusting the meter. For it appeared, from an inquiry at the works, that he had connected the pipe with the meter first, instead of with the pipe from the main, which latter he was effecting with a running socket so imperfectly united that sufficient gas escaped to destroy life. When we reflect that he was working with his head at the upper part of the closet, on a level with the fan-light of the door, he should have been doubly cautious; for when the gas escaped this part became a kind of gas-holder, and the deceased, having become insensible, was unable to lower his head beneath the frame of the fan-light; or had he but struggled and fallen, his life might have been spared.

In numerous instances gas appears to act like an anæsthetic agent by rendering the men, while at work, comatose, many of whom, when removed into the fresh air, gradually recover. They complain generally of a pricking sensation,

resembling that from pins and needles; there is stupor with violent headache, giddiness, nausea, and sometimes vomiting. The countenance is puffy and livid, being of a dark bluish-black colour; they look tipsy, and are obliged to be led, their legs giving way from under them, and the breath smells strongly of gas.

I made some further experiments, with Mr. Banister, on December 11th, which were conducted in the same manner as the preceding, except that the animals were rendered insensible only, and four were afterwards exposed to fresh air, but the other to the action of ammonia and fresh air.

I. *Experiment with common gas.*

A rat was stupefied in twenty-five seconds, after which it revived in thirty-five seconds on being placed in fresh air, and became quite lively.

II. *Experiment with common gas.*

A rat became insensible in thirty seconds, and afterwards recovered in fifty-five seconds on exposure to fresh air.

III. *Experiment with common gas.*

A rat was made insensible in thirty seconds, and afterwards placed under an inverted glass, having an opening at the top. A capsule containing a small quantity of ammonia was also put under the glass. The rat recovered in 105 seconds.

IV. *Experiment with cannel gas.*

A rat was stupefied in twenty-six seconds, and afterwards recovered in fifty-five seconds on exposure to fresh air.

V. *Experiment with cannel gas.*

Another rat, similarly treated, became insensible in twenty-nine seconds, and afterwards recovered in fifty-six seconds.

VI. *Experiment with common gas.*

This experiment was made on December 13th, when a rat was rendered insensible in thirty seconds, and afterwards passed through water into a large glass vessel filled with oxygen, where it recovered in eighty-five seconds.

From these experiments it appears that the animals recovered more quickly when exposed to fresh air than when other means were adopted.

ADDITIONAL EXPERIMENTS

ON THE

POISONOUS EFFECTS OF COAL-GAS

UPON THE

ANIMAL SYSTEM.

BY

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In the paper which I brought under the notice of the Society a short time ago upon this subject, the experiments were made with the gas as it issued from the main, but in those now to be related, common gas, diluted with atmospheric air in different proportions, was used. The experiments were made with Mr. Henry Banister, at the works in Horseferry Road, on February 7th and 14th, 1862.

Experiment I.

A gas-holder, capable of containing ten cubic feet of gas, having been filled with common coal-gas and atmospheric air in the proportion of one half of each, and a rat placed under a bell-glass, twelve inches in diameter, and six high, the contents were passed into it in the way described in the former experiments. The respiration became hurried, but we saw no gasping like that which took place during the previous observations. The head dropped in one minute, and the animal became insensible, with slight convulsion, in

one minute and a quarter, eyes staring as before; a spasmodic jerk of the body upwards occurred in two minutes, and death supervened in two minutes and a half. The surface of the skull was intensely red, without congestion of the substance of the brain. The blood fluid, and of a lighter colour than in the other dissections. Lungs collapsed, with redness of the pleura, excepting a darkish patch on the right side anteriorly, like that produced by smoke.

A rat, killed on February 6th, by common gas, was then examined twenty-four hours after death, to see if any material alterations could be detected between the post-mortem appearances found in it and in those examined immediately after death; still they were identical.

Experiment II.

After filling the gas-holder with one fourth common gas, and three fourths atmospheric air, the mixture was supplied to a rat placed under the same vessel. The respiration became hurried in three minutes, and the head dropped in five minutes, slight and repeated spasmodic action of the diaphragm in six minutes, which lasted five minutes more, when death followed.

The brain and lungs presented similar appearances to those described in the former experiments; but a smoky-looking spot appeared on the lower part of the right pleura, as in the last observation. Heart full of fluid blood, and not so dark-coloured as before.

Experiment III.

The gas-holder was filled three times, during this experiment with atmospheric air and common gas, the latter being in the proportion of one fifteenth. Hence thirty cubic feet of the mixture were passed into the vessel containing the rat. It fell in six minutes, and plunged at the end of eight minutes; the respiration was hurried in eight minutes, with another spasm, twitching of the left ear; the hurried

respiration continued, and the animal was thrown on the left side in half an hour and five minutes, the fur becoming elevated. The rat was taken out alive at the end of an hour. The quick respiration continued until the end. When placed in the open air it gasped and raised the head spasmodically while lying on the left side, yet ultimately recovered. Time did not permit me to continue this experiment; otherwise, I believe, that the rat would have died; indeed, it is probable that death would have taken place within the hour had the gas-holder been larger. We therefore determined to make another experiment with the same proportions of gas and air. The necessity of filling the apparatus twice after the experiment had begun gave two intervals for the animal to recover itself in some degree.

Experiment IV.—February 14th, 1862.

This experiment was made with the same proportions of gas and air as in the preceding one, but a gas-holder containing a much greater quantity was employed. The rat on being placed under similar circumstances, soon began to pant very fast, the head fell with inclination of the body to the right side in ten minutes, the head was subsequently raised and fell, which was followed by two springs of the body; sharp twitches of the body and left ear took place at the end of seventeen minutes, when the animal seemed to be insensible, with the eyes open. We observed a repetition of these symptoms in twenty-two minutes, and again in half an hour and three minutes. In forty-one minutes the respiration became laborious, when death occurred, twenty-five cubic feet of the mixture, or five cubic feet less than in the last experiment having been used. The eyes were open, and the surface of the skull intensely red. The brain congested, the blood being fluid and bright coloured. The pleura of a bright red colour, and the right side of the heart distended with darkish fluid blood. No redness in the trachea.

ON THE

TEMPERATURE, UREA, CHLORIDE OF SODIUM, AND URINARY WATER

IN

SCARLET FEVER;

AND ON A

CYCLE IN DISEASE AND HEALTH.

BY

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COMMUNICATED BY

DR. GARROD, F.R.S.

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These observations were made on inmates of the Hospital for Sick Children. The patients were under the care of Dr. West, Dr. Jenner, and Dr. Hillier. I beg to avail myself of this opportunity of thanking these gentlemen for affording me every facility in the prosecution of these investigations.

These experiments were undertaken to ascertain what relationship exists between the urinary excreta and the temperature in scarlet fever; and this paper is intended to be a sequel of my former paper on 'Ague' published by this Society.

The temperature is given in charts. The variations of each day are separated from each other by a red line, and

at the head of the column thus formed the day of the disease is given.

Above the temperature, five columns are given ; the first, gives the hour of the day ; second, gives the day of the month ; third, the daily amount of urea ; fourth, the daily amount of chloride of sodium ; fifth, the daily amount of urinary water. The urea and chloride of sodium are given in grammes ; the urinary water in cubic centimetres.

The urine was analysed daily ; and the amounts of the different constituents for twenty-four hours are put down on the day on which the urine was collected, and therefore belong to the previous day ; thus, when subsequently I refer to the urine of any day, I of course mean the urine collected on the morning of the following day.

The urea and chloride of sodium were analysed by Liebig's volumetric method. The chloride of sodium was not got rid of, but the usual allowance was made in estimating the quantity of urea.

The following are the subjects treated of :—1st. The temperature and its relationship to the urinary excreta. 2nd. The urea. 3rd. The chlorides. 4th. The urinary water. 5th. The albumen in the urine. 6th. The blood in the urine. 7th. A cycle in disease. 8th. A cycle in health, and its relation to the cycle in disease.

On the temperature in scarlet fever.

The duration of the elevation of the temperature varies ; thus, in seven cases it fell on the fifth day of the disease, in four cases on the tenth day, in two cases on the fifteenth day, in one case on the twentieth day, in two cases on the fourth day, in one case on the sixth day, and in two other cases the temperature fell so gradually, that it was impossible to say exactly on which day it reached its normal point.

It thus appears that in the large majority of cases the temperature falls on the fifth, tenth, fifteenth, or twentieth day, that is either on the fifth or a multiple of the fifth day of the disease ; so constant indeed is this, that if the

temperature should remain high on the fifth, tenth, or fifteenth day, we may look forward to a continuation of the fever for another five days. Further, in those cases in which the temperature continues high till the tenth, fifteenth, or twentieth day, it generally experiences a depression on the fifth day preceding its complete fall; for instance, if the temperature falls permanently on the fifteenth day, there generally occurs a depression of variable amount on the fifth and tenth days.

After each of these falls the temperature may rise again, reaching a point during the second five days, as high as, or higher than it did during the first five days, as in Cases 8, 17, 18, and 22. In other cases, after the fall on the fifth day, the temperature remains at this point till the following tenth day, on which day it experiences another abrupt fall, or it may gradually decline, passing almost imperceptibly into the normal temperature, reaching this point on the tenth day, as in Cases 5, 7, 16, 8.

Each of these falls in the temperature is accompanied by an improvement in the state of the patient, which is always in proportion to the extent of the fall. If the temperature again rises, the patient again relapses, but if it remains at the point it reached at its first fall the improvement is permanent.

The temperature does not usually attain the same height daily during each of the five days, but the point reached gradually increases during the second and third days, and then falls again towards the fifth; in some cases, however, it goes on increasing till the fourth day, and then experiences an abrupt fall on the fifth. It thus appears that the temperature (*i. e.* the fever) forms arcs or cycles, lasting over a period of five days. The height the temperature attained varied greatly in different cases; in some the elevation was just appreciable, in others it reached 105° Fahr.

Of seventeen cases that came early under notice, the average maximum temperature was a little over 103°. As might be expected, the temperature reached a higher point in the cases of long duration.

In some cases the highest elevation was attained on the first day, but in the severer cases it generally reached its highest point on the second or third, and perhaps not till the sixth or even the eleventh day.

Subsequent to the great fall experienced on the fifth, tenth, or fifteenth day, the temperature often remained over a variable period rather too high, the period being in some cases fourteen or fifteen days; the degree of elevation also varied, in some cases (Case 1) being between 100° and 101°, but more frequently between 99° and 100°. This slighter elevation of the temperature in most cases formed cycles of five days, as in Cases 2, 6, 10, and 11. In Case 11 this occurred after the second elevation on the twenty-sixth day.[1]

This slight subsequent elevation of the temperature, if of any persistence, is coincident with a continuance of the lesions produced by the scarlet fever; as, for instance, of the sore throat, or of the enlargement of the gland, or from discharge from the ears, &c.

There is no connection between the duration of the primary high temperature and the subsequent slighter one; thus, it can be seen (Case 1) that in some cases, where the great fall in the temperature occurred on the fifth day, a long subsequent slight elevation occurred; it must, therefore, have depended on the constitutional state of the patient. It certainly sometimes precedes Bright's disease.

At a variable period after the scarlet fever, a subsequent high rise in the temperature not unfrequently occurred, due to intercurrent disease. In many cases the nature of the intercurrent disease was determined, in other cases nothing capable of causing the elevation of the temperature could be discovered.

The day of the disease (counting from the commencement of the scarlet fever) varied. In the cases of albuminuria

[1] It must be borne in mind that in counting the second cycle of five days we must not take in the day of the fall, as this belongs to the previous cycle, but must begin to count from the day after this.

it began on the seventh, nineteenth, twentieth, twenty-third, twenty-ninth, and thirty-third days.

In those cases in which the elevation was probably due to heart disease, it began on the eighth day. In those cases in which the cause could not be determined, it began in one case on the eighth and in the other on the tenth. In one case of urticaria and chicken-pox it began on the sixth day. In a case of tuberculosis, on the ninth. The degree of the elevation of the temperature varied thus:

4 cases ranged between	102° and 103°
3 „ „	103° and 104°
4 „ „	104° and 105°
1 case it was	105⅕°.

The duration of the elevation varied; thus, in—

2 cases	the temperature fell	on the	second day.
1 case	„	„	fourth day.
3 cases	„	„	fifth day.
1 case	„	„	sixth day.
1 „	„	„	tenth day.
1 „	„	„	eleventh day.
1 „	„	„	thirteenth day.

The cause of the elevation also varied.

In 6 cases	it was due to	albuminuria.
In 1 case	„	tuberculosis.
In 1 „	„	chicken-pox.
In 2 cases	„	heart disease.
In 2 „	it was	uncertain.

On examining the previous cases, it will be seen that the rise in the temperature due to an intercurrent disease either fell on the fifth day from the commencement of its rise, or on the fifth day from the commencement of the scarlet fever; that is to say, the secondary rise in some cases adopts the cycle existing previously, or checks this and determines another.

Thus, in Case 1 the elevation lasted five days, and fell on

the twenty-seventh day of the disease, counting from the commencement of the scarlet fever.

In Case 17 the elevation fell on the fifth and tenth days from its own commencement, and as it began on the sixth day of the scarlet fever, it fell on the fifteenth day of that disease.

In Case 19 the secondary elevation fell on the fifth day from its own commencement.

In Case 22 it fell on the fifth, tenth, and twentieth days from its own commencement, and on the twelfth, seventeenth, and twenty-seventh of the scarlet fever. In this case I have counted the second rise from the eighth day, the two previous days being part of a previous cycle of the scarlet fever.

In the following cases the elevation caused by the intercurrent disease lasted a variable number of days, but fell on the fifth day, counting from the commencement of the scarlet fever.

Case 6.—It fell on the fourth day from its own commencement, on the tenth from the commencement of the scarlet fever.

Case 12.—It fell on the second day from its own commencement, on the twentieth from the commencement of the scarlet fever.

Case 20.—It fell on the thirteenth day from its own commencement; on the twentieth from the commencement of the scarlet fever.

In this case I have considered the second rise due to the intercurrent disease; to begin on the eighth day, and the two previous days to belong to the previous cycle of the scarlet fever.

Case 25.—It fell on the second day from its own commencement; on the twentieth from the commencement of the scarlet fever.

Case 26.—It fell on the sixth day from its own commencement; on the fifteenth, and again on the twentieth, from the commencement of the scarlet fever.

It is thus seen that the subsequent rise in the temperature

due to intercurrent inflammations, &c., strictly follow out the cyclical law, only one exception occurring; this was Case 23, in which the temperature fell on the sixth day from the commencement of the secondary rise, and on the thirteenth day from the commencement of the scarlet fever.

Sometimes after the fever had declined a sudden slight elevation occurred, limited to one day, and often to a few hours of the day, the patient being next day in the usual health and the temperature normal.

In 1 case it rose to	$102\frac{2}{5}$	on the	twenty-fifth day,	}	Counting from the commencement of the scarlet fever.
In 1 „	„	$100\frac{1}{5}$	„ fifteenth day,		
In 1 „	„	101	„ eleventh day,		

On the daily variations of the temperature.—In some cases the temperature remained at much the same height throughout the day; in other cases it fell a variable amount in the morning, and again rose during the day, forming a daily arc or cycle. The former generally occurred in the severer cases and at the commencement of the disease, and the latter at the termination, and may be taken as a sign of improvement. The time of the day at which the temperature reached its highest point varied between 9 a.m. and 11 p.m.; from 2 to 8 appears to be the most frequent hours. Two patients died from the immediate effects of the fever; one died on the fourth day of the disease; one died on the eighth day of the disease.

On the urea.

From the above cases it appears that the quantity of urea undergoes no increase with the elevation of the temperature, that is, during the fever days. If, indeed, we accept ·800 grms. of urea per kilogramme of weight as the amount normal per diem in children, it often suffered a great diminution.

It may, however, be objected that this is too high; and, secondly, that in many of the previous cases the urea falls

with the decline of the temperature, and that this shows that it had previously undergone an increase.

It may be fairly assumed, I think, that the amount of urea voided by these patients during the last ten or fifteen days of their residence in the hospital was not in excess of the quantity in health, especially where the examination extended over a long period (thirty or forty days), at which time the quantity of urea could not have been affected by any previous retention during the fever. Indeed, it appears to me that, leading a quiet, hospital life, and often spending the time in bed, that this amount is too low; but even accepting this amount as normal to the patient, on no occasion was the quantity of the urea increased during the elevation of the temperature; often, indeed, it was below it. This is shown in the following table, in which I have first given the daily average amount of urea per kilogramme of the fever days, and that of several of the last days during which the analyses were made.

Case 3.	From the second to the fourth day inclusive .	0·477
„	„ tenth to the twenty-eighth day inclusive	0·687
Case 4.	„ sixth to the ninth day inclusive .	0·527
„	„ nineteenth to the thirty-second day inclus.	0·706
Case 10.	„ second to the third day inclusive .	0·569
„	„ twelfth to the twenty-seventh day inclus.	0·642
Case 18.	„ second to the thirteenth day inclusive .	0·552
„	„ twentieth to the thirty-first day inclusive	0·634
Case 20.	„ tenth to the twelfth days inclusive .	0·561
„	„ twentieth to the thirty-sixth day inclusive	0·551

That the subsequent decrease in the amount of the urea is not due to the decline of the temperature is seen in some cases, as the 18th and 20th, in which the urea falls about the same time as in the other cases, in spite of a continuation of the elevation of the temperature, as the temperature in these cases continued high a long time after the decline of the urea; this disassociation of the urea and the temperature plainly shows that the decrease in the amount of the urea is independent of the temperature, and therefore their occa-

sionally occurring at the same time in no way shows that there was an increased elimination during the fever.

After the first few days the urea invariably falls, reaching point often considerably below the normal amount; thus, in—

Case 1.	The average daily amount per kilogramme, from the sixth to the fourteenth day inclusive, was	0·417
„	The normal amount was	0·642
Case 3.	The average daily amount per kilogramme, from the sixth to the ninth day inclusive, was	0·400
„	The normal amount was	0·687
Case 4.	The average daily amount per kilogramme, from the eighth to the fourteenth day inclusive, was	0·422
„	The normal amount was	0·706
Case 10.	The average daily amount per kilogramme from the fourth to the eleventh day inclusive, was	0·457
„	The normal amount was	0·642
Case 18.	The average daily amount per kilogramme, from the fifth to the sixth day inclusive, was	0·439
„	The normal amount was	0·634
Case 20.	The average daily amount per kilogramme, from the tenth to the nineteenth day inclusive, was	0·417
„	The normal amount was	0·551

A diminution of this kind usually occurs after the subsidence of fevers, due probably to the appetite not being completely restored, and also to the food being more thoroughly assimilated and tissue change not being so active.

But in these cases of scarlet fever the above explanation will not, I think, hold; for, first, the diminution in the urea usually lasts only over a few days after other fevers, whilst in these cases it often remained for many. Secondly, we have previously seen that there is no increase in the amount of the urea coincident with the increase in the temperature, and thus, probably, there is retention in the system, either of urea or some product capable of producing urea. In similar cases of retention in typhoid fever we have a subsequent increase in the amount of the urea, instead of the diminution. Thirdly, it has been before stated that the great diminution occurs quite independently

of the temperature, sometimes even when the temperature for several days remains at even 103°.

Thus I have tried to show that—First, there is no increase in the amount of urea during the fever. Second, that, subsequent to the fever, there is a great diminution of the urea, &c. Third, that this diminution cannot be explained in the usual manner. May the following be the explanation—namely, that the contagion has a similar action on the kidneys to that on the skin, tongue, and fauces, for we find in the urine epithelium from the bladder, pelvis of the kidney, and from the kidney itself, during the fever days. It may be objected that the impaired functional activity of the kidneys lasts longer than the rash, but the organs involved do not at once recover their normal condition on the disappearance of the rash, as is seen in the case of the tongue and fauces

In most of the cases, especially where the convalescence was slow, the children became puffy about the face, there being, however, no pitting on pressure; this occurred without the appearance of albumen or blood in the urine; perhaps this may be accounted for by the retention of urea in these cases being unusually marked.

On the occurrence of acute Bright's disease after the fever the urea was variously affected; in some cases it was greatly diminished in quantity.

Case 1.—The temperature rose on the twenty-third day to $102\frac{2}{5}°$, and then gradually fell during the following three days; on the fifth day it was normal again. Daily average amount per kilogramme, from the sixth to the twenty-first days inclusive, 0·464. During the following four fever (inflammatory) days, 0·373. The urea immediately regained its full quantity; thus, from the twenty-seventh to the thirty-fifth it was, per kilogramme, 0·641.

In the above case the albumen never amounted to more than a mere trace, and thus, probably, did not, to an appreciable degree, interfere with the quantitative analysis; the albumen lasted only during the five days of elevation of temperature, and hence, if it had any effect on the analysis,

it must be to give too great an amount of urea, and thus the diminution in the amount of urea will be greater than that given.

Case 12.—In this case, on the occurrence of the inflammation, blood (with a very large amount of albumen) was found in the urine; the albumen was removed by animal charcoal. The rise in the temperature occurred on the nineteenth day (105); on the following day it fell to 99 again. From the eighth to the eighteenth days inclusive, average daily amount of urea was 9·185. On the twenty-second day it was 1·875; on the twenty-third day it was 0·510.

I have given the total amount above, not the quantity per kilogramme, as they are so small during the above two days.

Case 24.—The urea was estimated quantitatively only till the twelfth day; after this it was discontinued till the sixty-third day, but, during the time, the patient had a severe attack of Bright's disease, with much blood and a large amount of albumen. On the fiftieth day she was much improved, on the sixty-first there was scarcely any anasarca, and from the sixty-third to the sixty-eighth the merest trace of albumen in the urine. Average daily amount of urea, per kilogramme, from the fifth to the twelfth days inclusive, 0·582. Average daily amount of urea per kilogramme, from the sixty-third to the sixty-eighth days inclusive, 0·268.

The last case not only shows how large the diminution often is, but that it may continue over a very long period, and long after active disease in the kidney has ceased.

Case 25.—Observations were made for eight days; on each day there was a variable amount of albumen, which was removed by animal charcoal; the temperature on three occasions rose gradually, over a space of three days, from normal to 105; the urea showed no corresponding increase on these days. The average daily amount for the eight days was only 10·241 grains. His weight was not taken, but assum-

ing 26 kilogrammes, for each kilogramme there was 0·093 grms.

In other cases no diminution occurred on the occurrence of the inflammation; thus, Case 25, on the twenty-ninth day, Bright's disease supervened, judging by the sudden elevation of the temperature, and the appearance of albumen and blood in the urine, yet, notwithstanding, the amount of urea continued as it was before or very nearly so. Thus, from the sixteenth to the twenty-eighth days inclusive, the average daily amount per kilogramme was 0·523 grms. From the twenty-ninth to the thirty-fourth inclusive it was 0·488 grms.

On the chlorides.

The chlorides were never absent from the urine that was analysed; the quantity, however, was always much diminished during the fever days; thus, in—

Case 3, the daily average amount per kilogramme, from the second to the fourth day, was . . . 0·032
Case 10, the daily average amount per kilogramme, from the second to the fourth day, was . . . 0·054
Case 20, the daily average amount per kilogramme, from the first to the fourteenth day, was . . . 0·080
Case 24, the daily average amount per kilogramme, from the fifth to the twelfth day, was . . . 0·093

During the three or four days following the fever the quantity of chloride increased gradually; thus, in

Case 3, the average daily amount per kilogramme, from the fifth to the eleventh day, was . . . 0·093
Case 10, the average daily amount per kilogramme, from the fifth to the eleventh day, was . . . 0·125

After this they became normal in quantity; thus, in

Case 3, the average daily amount per kilogramme, from the tenth to the twenty-fifth day, was . . . 0·210
Case 10, the average daily amount per kilogramme, from the thirteenth to the twenty-seventh day, was . . 0·228

In one case of Bright's disease the chlorides suffered scarcely any diminution in their quantity during the fever days; thus, in Case 1—

Average daily amount per kilogramme, from the twenty-third to the twenty-sixth day (fever days) . . .	0·110
Average daily amount per kilogramme, from the twenty-seventh to the thirty-fourth day (non-fever days) .	0·134

It still remains doubtful whether the chlorides are eliminated as a secretion, or merely as a solution in the urinary water; if it be secreted by the kidney through any diminution in the secretive power of the kidney, it should show itself in a diminution of the amount of the chloride of sodium.

In the case given above there was a decided diminution in the amount of urea during the fever days of Bright's disease, and this, I have attempted to show, was due to diminution in the secretive power of the kidney. But in this case the chloride of sodium was scarcely diminished; thus, this single case would go to show that the urea passes out in the form of a solution. The close relationship also between the amount of chloride and the urinary water tends to prove the same conclusion.

On the urinary water.

During the fever days the amount of urinary water varies very greatly; thus, in—

Case 10,	the average daily amount per kilogramme was	11	c.c.
„ 3,	„ „	12	„
„ 4,	„ „	18	„
„ 20,	„ „	20·2	„
„ 18,	„ „	35·3	„
„ 24,	„ „	66	„

During the subsequent non-fever days the amount also varied somewhat; thus, in—

Case 2,	the average	daily amount	per kilogramme	was 17 c.c.
„ 18,	„	„	„	22 „
„ 24,	„	„	„	23 „
„ 3,	„	„	„	25·9 „
„ 4,	„	„	„	26 „
„ 10,	„	„	„	28·4 „
„ 20,	„	„	„	27·6 „
„ 25,	„	„	„	29·4 „

These last quantities may, I think, be taken as the amount usual per kilogramme in children; this gives an average of 24·6. I am aware this is much below the amount usually received; thus, Dr. Parkes[1] gives 59 c.c. The above quantity agrees very closely to the amount given by Dr. Parkes per kilogramme in adults.

If this assumption be correct, it follows that often, during the fever days, there is no decline in the amount of urinary water, and in some cases there is a very large excess.

On the albumen in the urine.

The albumen appears at two different periods; first, during the fever, and second, later—about the third week—at which time it is often much larger in quantity, longer in its duration, and accompanied by a second elevation of the temperature.

1st. Its appearance during the fever days, out of twenty-one cases in which the urine was examined.—In only one did any albumen occur; it was slight in amount, and was present on the fifth and sixth days. It must be borne in mind, however, that in many of these cases several of the fever days had elapsed before their admission.

2nd. Its appearance during convalescence of eighteen patients who were in the hospital for a considerable time.—Seven had albumen during the period; three other cases are given; these were admitted with albuminuria.

[1] 'On Urine,' p. 44.

The time of its appearance varied; thus—

In Case 6 it appeared on the ninth day.
„ 25 „ eighteenth day.
„ 12 „ twentieth day.
„ 1 and 19 „ twenty-third day.
„ 11 it first appeared on the eleventh day, but after a day or two it discontinued, and reappeared on the twentieth.

The duration of the albuminuria varied; thus in—

Case 1, it lasted three days.
„ 6, „ eleven days.
„ 25, „ twenty days.
„ 11, „ more than twenty-seven days.
„ 19, „ „ forty-three days.
„ 12, „ „ forty-nine days.

Taking the elevation of the temperature as a test of the severity of the inflammation, it is seen that there is no necessary connection between the intensity and duration of the inflammation and the duration of the albumen in the urine. This can be seen by comparing the following table with the one above:

Case 1, the temperature reached 102, and lasted four days.
„ 6, „ 103, „ three days.
„ 25, „ 104, „ one day.
„ 19, „ 102°, „ four days.
„ 12, „ 105, „ one day.

Moreover, there is no necessary relationship between the temperature and the amount of the albumen. This can be seen by comparing the following table with the one above:

Case 1, very slight trace.
„ 6, an enormous amount.
„ 25, very slight trace.
„ 19, very large quantity.
„ 12, a large quantity.

The albumen appears in the urine very soon after the elevation of the temperature; thus, in—

Case 1, the temperature rose on the twenty-third day; albumen appeared on the twenty-third day.

Case 6, the temperature rose on the seventh day; albumen appeared on the ninth day.

Case 11, the temperature rose on the eleventh day; albumen appeared on the eleventh day.

Case 12, the temperature rose on the nineteenth day; albumen appeared on the twentieth day.

On blood in the urine.

Relationship between the elevation of the temperature and the appearance of blood in the urine:

1st. No blood may follow the rise of the temperature. Case 1, there was no blood. Case 6, never smoky; urine not examined microscopically.

2nd. In those cases in which blood appeared its appearance was always preceded by a rise in the temperature. Case 11, temperature rose on the twentieth day; blood appeared on the twenty-first. Case 12, temperature rose on the nineteenth day; blood appeared on the twentieth. Case 25, temperature rose on the twenty-ninth day; blood appeared on the twenty-ninth.

The blood in some cases continued long after the decline of the temperature; thus, the continuance of blood cannot be taken as evidence of a continuation of the inflammatory action of the kidney; thus, in Case 11, the temperature fell on the twenty-seventh; the blood continued in the urine till the thirty-seventh day. Case 12, the temperature fell on the twentieth; the blood continued in the urine till the twenty-first day. Case 19, the temperature fell on the thirty-seventh; the urine contained blood till after the sixty-fifth day. Case 25, the temperature fell on the thirtieth day; the urine contained blood till the forty-first day.

Relationship between the blood and the amount of albumen in the urine.

1st. A very large amount of albumen may occur in the urine without any blood, as in Case 6.

2nd. Blood, even to a large amount, may exist with the slightest trace of albumen; and if the blood-corpuscles be allowed to settle to the bottom of the vessel, the supernatant fluid may give no evidence of any albumen by heat and nitric acid, as in Cases 25 and 30.

The cases given were seldom dropsical to the extent of pitting; they, however, often looked puffy in the face. Seven cases gave no pitting on pressure; one case very slight; one case the body pitted deeply on pressure.

In some cases the second elevation of the temperature was followed by a puffiness.

In one case the patient was puffy about the face, without any elevation of the temperature or other evidence of Bright's disease.

In some cases the puffiness about the face preceded the rise of the temperature one or two days. In other cases the rise in the temperature preceded the puffiness[1] for a variable number of days; thus, in Case 6, six days; Case 11, three days; Case 12, one day.

On a cycle in disease.

In these cases it appears that the temperature does not run an equable course, neither remaining at the same temperature throughout, nor observing a period of elevation and decline, but forms arcs or cycles composed of a variable number of days, each cycle, however, being composed of the same number of days in the same patient.

We see from the cases given that no number of days

[1] When I use the term puffy, there was no pitting of the body on pressure.

composing the cycle is peculiar to any disease, but that five days is the most common in all.

In rare cases, in the same patient the number of days composing the cycle may change.

For a further account of the cycle in disease, I must refer to the account given of the temperature.

On a cycle in health.

We have seen that in fevers the temperature forms cycles, and as the variations in the temperature are due to the variations in the amount of tissue change, it follows that we must have a cycle of tissue change. Does such a cycle exist in health? I think it probable, and that this determines the cycles in fever, and not the disease itself, for—

1st. In the same disease the cycle may be composed of a different number of days, the cycle, however, remaining constant in the same patient. If the disease determined the cycle, we should expect it to be composed of the same number of days in all patients, whilst we can readily conceive different people to have a different cycle.

2nd. Different diseases (as scarlet fever, followed by Bright's disease, heart disease, chicken-pox, &c.), occurring in the same patient, adopt the same cycle.

3rd. Not unfrequently after the decline or during the decline of the scarlet fever a second elevation of the temperature occurred, due to some intercurrent disease. This second elevation of the temperature lasted over a very variable number of days, but, with one exception, it fell on either a fifth day from its own commencement or on a fifth day from the commencement of the scarlet fever.

In the latter case the intercurrent elevation of temperature, if of some duration, forms cycles, the first of which cycles only is irregular, the subsequent ones being composed each of five days. If the intercurrent inflammation determined the cycle, we should have expected its first cycle to have lasted five days also, instead of which it appears to adopt a previously existing one; but having commenced in

the middle, it is composed of a shorter number of days. This will be more clearly shown by a typical case.

A case of scarlet fever in which the temperature forms cycles of five days, having again fallen to the normal temperature, is followed on the twenty-second day by another elevation, due to intercurrent disease; this experiences a fall on the twenty-fifth, thirtieth, thirty-fifth, and fortieth days from the commencement of the scarlet fever. The three last cycles of the intercurrent disease being each composed of five days, shows that the normal cycle is one of five days, and that the one which immediately preceded them, composed of only four days, is irregular, but only with regard to its commencement, as its fall takes place on a fifth day from the beginning of the scarlet fever.

The previous elevation of temperature of the scarlet fever affords data from which we can calculate the subsequent cycles, and the intercurrent inflammation corresponds exactly with these, with the exception of the elevation of temperature of the imperfect cycle, which begins in the middle of one, showing that diseases adopt previously existing cycles. In the other case, in which the intercurrent inflammation falls on the fifth day from its own, and not from the fifth day from that of the scarlet fever, it is probable that the intercurrent disease cuts short the immediately preceding cycle, but another one commencing it adopts this.

It may, however, be said that this cyclical condition preceding and influencing any subsequent inflammation was established by the preceding scarlet fever; this I think improbable, for the following reasons:

(A) If the disease determines its cycle, it appears difficult to me to conceive that it should be amenable to the influence of a previous disease, whilst it is readily explained by the supposition that both are influenced by a cycle existing in health.

(B) It is difficult to conceive how the scarlet fever should affect the cycle of a subsequent intercurrent disease, occurring

as it sometimes did, so many days afterwards, in some cases the subsequent elevation not occurring till the thirtieth day.

(c) In a case of pneumonia, the temperature of which I took, the first cycle was composed of six days; this was followed by a cycle of ten days (two five days' cycles) and by a five days' cycle. This is a case similar to those occurring after Bright's disease, in which the elevation began probably in the middle of a cycle; but in this case there was no preceding fever to give rise to a cycle which could modify the subsequent elevation, and as it began probably in the middle of a cycle, of course this implies its previous existence, that is, in a state of health.

It may be said this cyclical variation in health can be at once put to the test by taking the temperature in health, and seeing if any such variation exists. But in speaking of cyclical changes of tissue, I mean nitrogenous tissues solely, of which the temperature in fevers is the exponent; for in fevers probably the hydrocarbons are not at all attacked, for it is said the amount of carbonic acid is not increased, and I have attempted to show in a previous paper that in ague the temperature holds the closest correspondence to the amount of urea excreted, that is, to the amount of nitrogenous matter consumed.

But in health the temperature is largely derived from the combustion of the hydrocarbons of the body, and thus it cannot be taken as a guide to the change occurring in the nitrogenous tissues; indeed, in health it is probable that the hydrocarbons and the nitrogenous tissues are reciprocal.

Dr. Parkes tells me he has noticed that the urea in Bischoff's and Voet's experiments observed cyclical variations.

Thus, I think it probable that in health we have cycles of tissue (nitrogenous) changes, and in fevers we have the same greatly increased. But if this correspondence holds good between the cycle of health and disease, it is probable that it holds as to the constituent parts of the cycle; and if so, we have a daily cycle in health corresponding to that in fevers, but of a less degree.

If the above views be correct, it follows that in fevers we have but an increase of the normal tissue change, amenable to the ordinary laws of health.

On the temperature in fevers.

On looking over the cases given, it will be seen that in some the temperature remains almost permanent at an elevated point; in others there are daily elevations and falls of variable intensity; the persistence of the elevation of the temperature occurs during the most severe period of the fever; as it improves, the highest point the temperature reaches may remain the same, but the daily fall increases, this being often the earliest indication of improvement. This has been already noticed in typhoid, but it also holds good in scarlet fever, but to a less degree, partly owing to the fever throughout its course being severe, not having a period of slow increase and decline; however, even under these circumstances, it is not so marked as in typhoid fever.

The manner in which the temperature becomes persistent during the more severe time of the fever appears to me to be the following.

There is originally a daily rise, or perhaps it is limited to a part of a day; but as the fever increases in severity, not only does the extreme elevation of the temperature increase, but also the duration of the daily fit; indeed, after the temperature has attained a variable height, it ceases to rise higher, but the duration of the rise continues to increase.

Thus, suppose it possible to isolate a distinct fit, consisting of the rise and fall of the temperature, in a severe case the temperature, not having had sufficient time to reach its normal point on one day, would encroach on the following; but there occurring another rise on the second day, before the previous rise has had time to complete its fall, the temperature of the two days coalesce at a certain point, and the longer the duration of the separate fits the higher will be the point at which they will coalesce. These steps are best followed in typhoid fever, in which, at the commence-

ment and decline of the fever, we often have a complete daily fit, in some cases rising from the normal temperature to 105°, and again falling to the normal temperature; this may be repeated for several days;[1] as however, the fever increases in severity the daily falls in the temperature diminish till the fever becomes almost persistent in severity.

The same occurs also in miasmatic fevers. In these, when not severe, we have daily a complete fit; but as the fits increase in severity the fever becomes continuous, and as it again declines it first becomes remittent, and ultimately intermittent.[2]

From the above it follows that, theoretically, we have no such thing as continued fever.

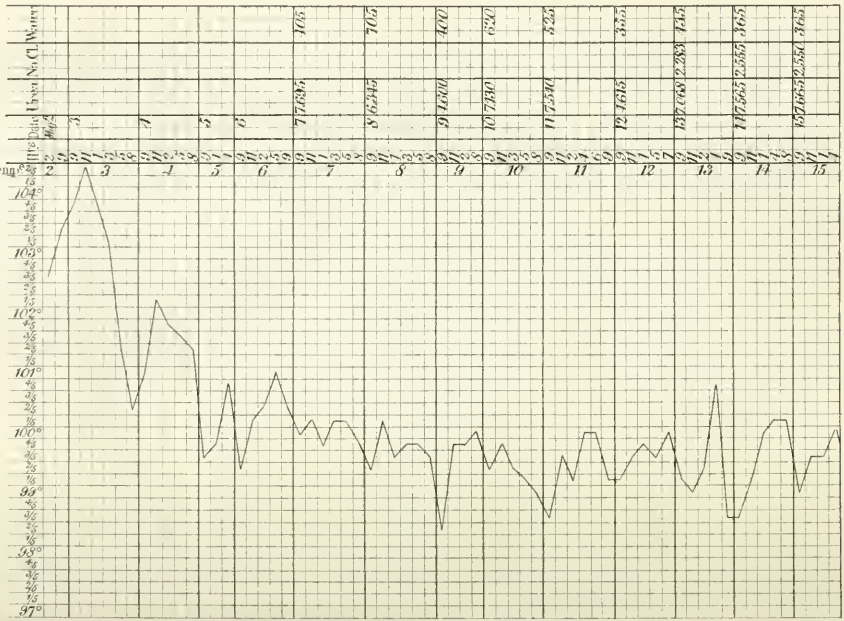
On looking over the above case, it will be seen that the time of the day at which the elevation of the temperature begins varies greatly; thus, it may begin early in the morning, and in rare cases its commencement may be postponed till 4 p.m. or even 9 p.m. If fevers be merely an exaggeration of the normal daily cycles, it follows the commencement of the fever will correspond to the commencement of the normal cycle of that day; this will account for the various hours of the day at which the fever first begins. In scarlet fever we can fix the commencement of the attack with the greatest precision, as is well known; it may begin at almost any hour of the day; thus, in the cases given, it began in one case at 1 a.m., two cases during the morning, one case at 11 a.m., three cases at 12 a.m., one case at 2 p.m., four cases at 5 p.m., one case at 10 p.m., one case during the night.

By observing the variation in the elevation of the temperature, we may learn the variations in health; from this we see that the period of the day at which the temperature reaches its maximum varies greatly on different days of the

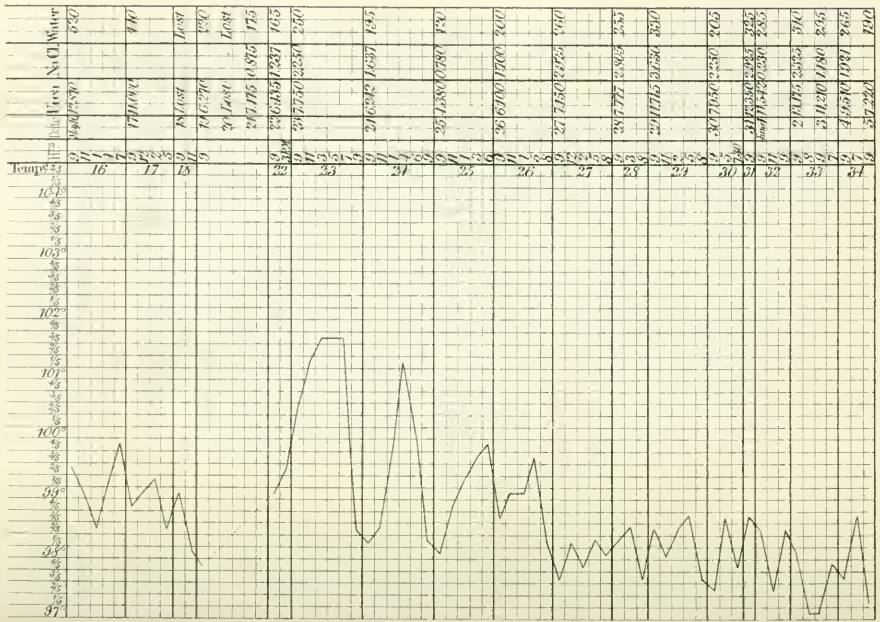
[1] Not only have we in these cases a distinct fit as regards the temperature, but also as regards the symptoms, there occurring in these cases a distinct hot and sweating stage daily.

[2] 'Wood,' vol. i, p. 240.

Case I. Henry Maydin.



Henry Maylin. *Cont^d*



same case; thus, it may reach its maximum at 9 a.m., or as late as 10 p.m., or at any other intermediate hour.

Dr. Edward Smith has shown that there is a daily capacity for increased tissue change. He has endeavoured to show that this occurs during midday; from the above cases it appears that it may occur at any hour of the day.

The cases from which the preceding deductions are made are now added. I have been obliged to omit many of the charts of temperature, owing to the great expense. The Council of the Society, have, however, kindly allowed me to retain the most typical.

Case 1 (see Diagrams 1, *a* and *b*).—Henry Maylin, æt. 6; weight, 16 kilogrammes. He was seized at 5 p.m., May 1st, with shivering, and complained of some sore throat; during the night he was heavy and feverish.

The rash appeared on the second day of the disease, and disappeared on the eighth. The rash was strongly marked on the second day of the disease; from that time it gradually faded.

Desquamation began on the sixth day of the disease, was completed generally between twenty-second and twenty-sixth days, though some still continued on the hands and feet on the twenty-ninth day. The desquamation was most marked under the clavicles and over the pubes.

The conjunctivæ were very much injected on the second day of the disease; this then declined, and ceased on the seventh day.

The glands at the angle of the jaw were found to be rather enlarged on the second day. From the sixth to the eighth days inclusive they were still more enlarged, and, indeed, increased in size till the twenty-third day. On the twenty-sixth day they had begun to diminish. Glands down the upper half of the neck posterior to the sterno-mastoid were rather enlarged and shotty till the twenty-sixth day of the disease, when they were found to be normal. Glands in groins were found to be enlarged on the second day; they increased in size till the seventh day inclusive,

after which they diminished, and became normal between the twenty-second and twenty-sixth day of the disease.

The tongue was thickly coated on the second day; from the fourth to the sixth inclusive it was of the well-marked strawberry kind; after this it improved, and became normal on the eleventh day.

The tonsils were vividly red and swollen till the fourth day; all redness had disappeared on the eleventh day, but they were found still enlarged on the twenty-fourth day.

The boy's appetite improved on the fourth day, and remained good till the twenty-second; on the twenty-eighth day it again became excellent.

Heart was healthy on the sixth day; no other note was made until the eleventh day, when systolic basic murmur was heard audibly at the second left cartilage; this continued audible till the fourteenth day, and disappeared suddenly on the fifteenth; from this time to the time of his dismissal from the hospital his heart sounds continued normal.

Some cough was noticed on the seventh day of the disease; on the twenty-second day it was very troublesome, and had all the character of hooping-cough, and continued so till the time of his discharge.

The boy was delirious only on the night of the second day of the disease.

Urine.—The urine was examined daily; no albumen was found till the twenty-fourth day, on which day there was a very distinct cloud on boiling and adding nitric acid; after this it decreased in quantity and disappeared on the twenty-seventh day; subsequent to this the urine always remained free from albumen; no blood nor casts were detected.

General appearance.—Till the tenth day the lips were dry, and the boy heavy; after this he steadily improved, though very slowly so, till the nineteenth day, when he flagged again, and on the twenty-second was puffy about the face, and the angles of his mouth and along the nose were ulcerated; after the twenty-third day he improved, though he still looked puffy till the twenty-sixth day. There was no distinct pitting on pressure any time.

Diet.—Second day, beef tea 1 pint, milk 1 pint, wine 4 oz.; seventh day, pudding diet, wine 3 oz.; eleventh, wine 2 oz.; thirteenth day, fish; twenty-first, second meal diet, 2 oz. of meal, 3 oz. of potatoes.[1]

Case 2.—Henry Johnson; height, 3 feet 1½ inch; weight, 10 kilogrammes. The child was seized during the night of the 23rd of May.

The rash appeared on the second day of the disease, disappeared on the seventh.

Desquamation, which was slight and very superficial, began on the tenth day, still continued on the feet on the twenty-ninth day. Glands at the angles of the jaw were rather enlarged, even on the twenty-ninth day. Glandula concatenatæ were not enlarged till the ninth day; on that and the following day both they and the glands at both angles were enlarged; on the twelfth day they were normal on the right side, but continued enlarged on the left till the twenty-third. Glands in groins were shotty till the tenth day.

Tongue was very red with prominent papillæ from the fourth to the sixth day inclusive; it then improved, and became normal between the fourteenth and nineteenth days.

Fauces, &c., were red and swollen on the fourth; after this the parts improved, and were normal on the tenth day. Appetite was pretty good on the fifth day; after this it continued excellent.

Heart was healthy throughout.

Lungs.—There was some sonorous rhonchus on the fourth, fifth, and sixth days.

Urine was examined daily; it never contained any albumen.

General appearance.—Throughout the time he was under observation he looked quite well.

Diet.—May 26th, milk 1 pint, beef tea 1 pint, bread and butter; 31st, pudding diet; June 4th, broth diet; 10th, second meal diet; 16th, pudding diet, milk half pint.

Table showing the daily amount of urea, chloride of sodium, and urinary water, excreted.

Day of disease.	Urea.	NaCl.	Water.
	Grammes.	Grammes.	
Fifth	5·642	1·313	185 c.c.
Sixth	6·120	2·486	255
Seventh	8·100	4·050	360
Eighth	8·100	4·225	360
Ninth	7·965	1·485	270
Tenth	10·660	3·382	410
Eleventh	9·190	2·480	310
Twelfth	6·045	1·782	310
Thirteenth	7·695	2·389	405
Fourteenth	6·840	1·680	380
Fifteenth	Lost	Lost	Lost
Sixteenth	8·625	1·983	345
Seventeenth	8·407	1·778	295
Eighteenth	6·697	1·081	235
Nineteenth	4·702	1·650	165
Twentieth	7·055	2·695	245
Twenty-first	7·875	2·250	250
Twenty-second	7·370	1·650	220
Twenty-third	8·360	1·650	220
Twenty-fourth	8·750	2·625	250
Twenty-fifth	10·867	3·450	345
Twenty-sixth	7·095	2·257	255
Twenty-seventh	10·075	3·332	310
Twenty-eighth	9·440	2·802	295
Twenty-ninth	7·685	2·030	290
Thirtieth	8·000	1·875	250

The temperature reached its lowest point on the fifth day of the disease.

Case 3.—John Franklin, æt. 11 years 6 months; assumed weight, 30 kilogrammes. The boy has felt poorly during the last fortnight, complaining of headache and sickness, but continued at his work till January 17th, on which day he vomited once or twice, and on the same evening the rash appeared.

Rash was general, second, third, and fourth days. Disappeared on fifth.

Desquamation began on the hand and leg on the eighth day, was general by the sixteenth; patient discharged on the

twenty-ninth. Desquamation then completed, except on the limbs.

Tongue thickly coated with white fur on the second day, was strawberry from the fourth to sixth inclusive. After this it improved.

The tonsils, pharynx, &c., were very red on the second and third days. They improved from the sixth.

The appetite improved on and after the sixth day.

The boy improved in appearance greatly on the fifth day.

The urine never contained any albumen.

Table showing the daily amount of urea, chloride of sodium, and urinary water excreted.

Day of disease.	Urea.	NaCl.	Water.
	Grammes.	Grammes.	
Third	11·160	0·465	310 c.c.
Fourth	15·624	1·176	420
Fifth	16·175	1·290	430
Sixth	Lost	Lost	.....
Seventh	11·882	2·425	485
Eighth	13·563	3·255	775
Ninth	15·960	3·657	665
Tenth	6·676	1·862	245
Eleventh	15·750	7·000	700
Twelfth	13·982	6·098	595
Thirteenth	14·965	8·200	820
Fourteenth	16 877	5·887	785
Fifteenth	15·562	7·750	750
Sixteenth	19·080	4·402	795
Seventeenth	22·370	4·698	895
Eighteenth	22·372	6·969	1010
Nineteenth	23·205	6·915	.....
Twentieth	19·550	6·375	850
Twenty-first	21·750	4·575	750
Twenty-second	22·230	6·184	780
Twenty-third	24·000	6·400	800
Twenty-fourth	22·500	8·190	900
Twenty-fifth	22·312	6·512	875
Twenty-sixth	25·440	.....	1060
Twenty-seventh	23·010	6·016	885
Twenty-eighth	19·500	4·950	825
Twenty-ninth	27·502	6·755	965

The temperature reached its lowest point on the sixth day of the disease.

Case 4.—William Stephens, æt. 5; height, 3 ft. 1 inch; weight, 14 kilogrammes. On April 25th he vomited, complained of sore throat, and had a slight cough. On April 26th he had a slight blush of redness all over him; this increased in intensity till April 28th. Admitted on the sixth day of the disease; all the rash had disappeared, leaving a yellowish mottling. No desquamation occurred till the twenty-fifth day, when there was slight superficial but decided desquamation on the thighs, legs, and dorsum of feet; none on the soles of the feet, slight also on both shoulders. No further note was taken till the twenty-ninth day, when all desquamation had ceased.

Glands at the angles of the jaw were very much enlarged from the sixth to the nineteenth inclusive; they then declined, but still were too hard on the twenty-ninth.

Neck, first noted on the seventeenth, and to the twenty-second inclusive they were enlarged, that is to say, those close to the head, those immediately above the clavicle, were normal.

Groin, from the sixth to ninth inclusive, they were enlarged, hard, and shotty; they then declined, and on the twenty-fifth were normal in size, but too hard. On the twenty-ninth the left were normal, but the right were still too hard. On the seventh and eighth days were seen several red, hard elevations, about the size of peas, not unlike bug-bites, but without any central black spot or trace of bite; these were surrounded by a little ring of redness. The ala of his nose were excoriated, and discharged at the time of admission, and continued in much the same state till the twelfth day, when it was rather better, but still remained red and excoriated till the twenty-fifth day, when they were all but healed.

Tongue thickly coated; tip and edge red, with prominent papillæ, sixth to eighth day inclusive; fur cleared off from the anterior part, but did not leave it red, on the ninth; from the eleventh day inclusive it was normal.

Tonsils.—Tonsils, uvula, &c., very deeply injected and swollen, whole posterior fauces covered with a thick, tena-

cious, opaque-looking membrane, from the sixth to eighth day inclusive. The redness then declined and the membrane thinned away, till, on the fourteenth, the membrane was replaced by a more purulent-looking matter. On the fifteenth the parts were decidedly better, and on the nineteenth they were normal.

The child's appetite was bad till the eighth day inclusive; it then improved, and after the ninth day continued excellent.

Heart healthy throughout.

Some sonorous rhonchus on the seventh, eighth, and ninth days; lungs otherwise healthy.

Throughout the time he was in hospital the child looked tolerably well; rather pale.

Urine at no time contained any albumen.

The child was admitted on the sixth day of the disease. On the sixth day the temperature rose to $102\frac{3}{5}$; on the seventh to $102\frac{3}{5}$; on the eighth to $100\frac{3}{5}$; on the ninth to 100; and on the tenth to 99. After this it daily rose to 99 till the nineteenth day.

Table giving the daily amount of urea, chloride of sodium, and urinary water excreted.

Day of disease.	Urea.	NaCl.	Water.
	Grammes.	Grammes.	
Seventh	7·477	...	245 c.c.
Eighth	10·080	.....	320
Ninth	5·740	.....	205
Tenth	6·240	.....	240
Eleventh	5·290	.....	230
Twelfth	6·977	.....	325
Thirteenth	5·945	.....	290
Fourteenth	4·857	.....	355
Fifteenth	6·300	.....	420
Sixteenth	8·600	.....	400
Seventeenth	7·540	.....	580
Eighteenth	8·225	.....	470
Nineteenth	8·505	2·391	315
Twentieth	10·360	3·420	380
Twenty-first	10·450	3·420	380
Twenty-second	11·895	.....	390
Twenty-third	11·025	.....	315

Day of disease.	Urea.	NaCl.	Water.
	Grammes.	Grammes.	
Twenty-fourth ...	12·425	.....	350 c.c.
Twenty-fifth	10·020	.....	380
Twenty-sixth.....	Lost	.....	.....
Twenty-seventh...	8·640	2·764	270
Twenty-eighth ...	10·370	3·400	340
Twenty-ninth ...	9·715	2·827	290
Thirtieth	7·525	1·128	215
Thirty-first.....	6·880	1·612	.....
Thirty-second ...	9·310	4·650	490

Case 5 (see Diagram 4).—Charles Macdonald, æt. 5½. Seized on September 25th; rash first appeared on the 27th; sore throat on the 26th. Rash was universal, and most remarked over the legs on the fourth day, then declined, and only a slight punctiform redness on the legs on the eighth day of the disease. Desquamation began about the ears and trunk on the eighth day. Glands at the angles of the jaw and in the groins were enlarged. Numerous sudamina noticed on the fifth day.

Tongue devoid of fur, rather red; papillæ rather prominent on the fourth day; tongue pale on the fifth and eighth days, and was normal on the eleventh.

Fauces, &c., rather red, but not swollen, on the fourth day. The redness disappeared, but they were rather swollen and covered with muco-purulent matter on the fifth day; natural on the eighth; no note taken between fifth and eighth days.

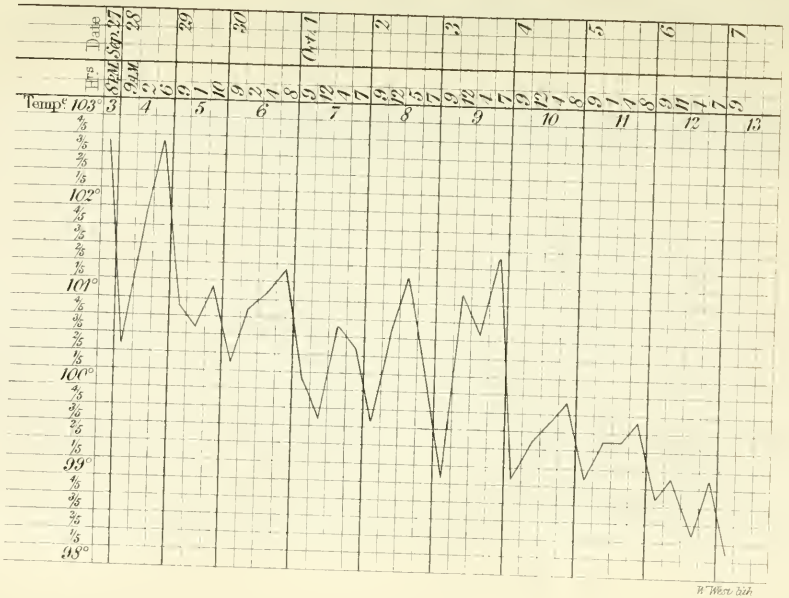
Appetite never bad.

Urine examined daily to the sixteenth day. No albumen at any time in the urine.

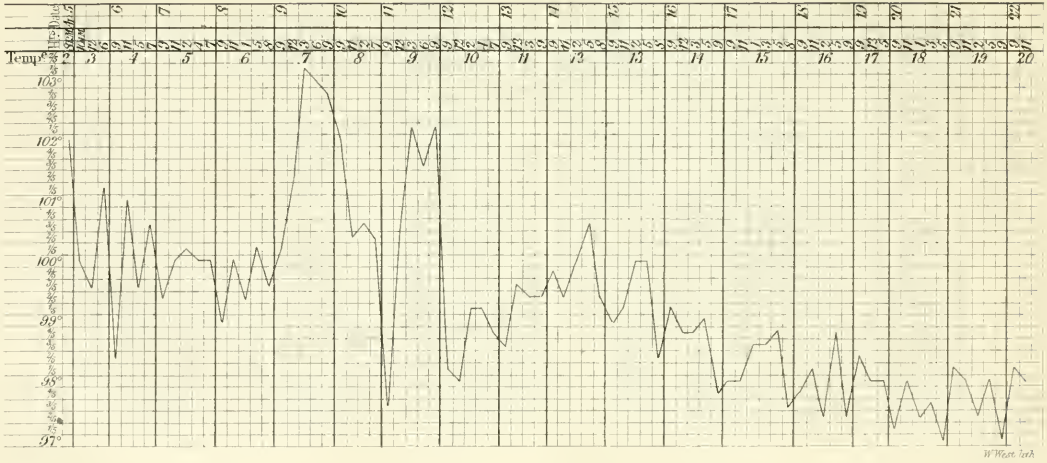
A very slight attack. Marked improvement was noticeable, however, with each fall of the temperature.

Case 6 (see Diagram 3).—Thomas Stephens, æt. 4. Rash appeared on the second day of the disease, and lasted only one day. Desquamation began on the eleventh day. It had all but ended on the seventeenth day. On the third

Case 5. Charles Macdonnell.



Case 6. Thomas Stephens.



day the child greatly improved, and continued to mend till the seventh day, when he became restless and dull. On the eighth day numerous wheals of urticaria appeared on his arms; these continued to appear till the eleventh day, on which day they had all disappeared.

Urine was tested daily. On the ninth day there was a slight cloud of albumen; tenth, ditto; twelfth, there was a very large quantity of albumen; thirteenth, enormous amount of albumen; fourteenth, ditto; fifteenth, the quantity of urine greatly increased, the albumen less; sixteenth, ditto; seventeenth, no albumen in the urine; eighteenth, distinct cloud discovered; nineteenth, slightest trace; twentieth and twenty-first, no albumen.

On the twelfth day the child was drowsy; on the fifteenth he was rather puffy about the face. At no time was there any pitting of the legs nor face on pressure.

Heart always healthy.

Case 7.—Duchatel, male, æt. 5 years 6 months; was seized on October 12th, between dinner- and tea-time. Rash appeared on the thirteenth; on the third day of the disease the temperature reached 103°; on the fourth, $102\frac{2}{5}$; on the fifth, $100\frac{4}{5}$; on the sixth, 101; on the seventh, 100; on the eighth, $98\frac{2}{5}$; on the ninth, 99; on the tenth, 98.

Case 8.—Welsh, male, æt. 3 years 6 months. On the ninth day of the disease the highest temperature was $102\frac{1}{5}$; on the tenth, $101\frac{3}{5}$; on the eleventh, $103\frac{1}{5}$; on the twelfth, $102\frac{2}{5}$; on the thirteenth, $103\frac{1}{5}$; on the fourteenth, $101\frac{2}{5}$; on the fifteenth it fell throughout the day, and reached $99\frac{1}{5}$, and continued afterwards at about this temperature.

Case 9.—Eliza Brown, æt. 11 years. Rash appeared on the second day. The urine contained no albumen during her stay in the hospital. On the second day of the disease the temperature rose to 102; on the third, 102; on the fourth, 99; and continued at this last temperature on all the following days.

Case 10.—Anne Johnson, æt. 7; height, 3 ft. 5½ in.; weight, 16 kilogrammes. She first complained of some sore throat at dinner-time, May 25th, but continued in other respects in her usual health till tea-time, when she lay down and complained of headache and chilliness. During the night she was feverish and vomited.

The rash appeared on the second day of the disease, and disappeared on the sixth. Desquamation began on the sixth day of the disease, and was almost completed on the twenty-seventh. Some miliary vesicles were observed on the third day. The conjunctivæ were injected on the second and third days of the disease.

The glands at the angles of the jaw were never enlarged. The glandula concatenatæ were rather enlarged and hard till the twelfth day, when they were found to be normal. In the groins they were enlarged to the size of peas and beans; they became normal between the sixteenth and nineteenth days.

The tongue was very little affected; it was red, with prominent papillæ at the tip and edges, till the seventh day, and was normal on the twelfth.

The throat was vividly red and rather swollen on the second and third days. It became healthy on the eighth.

The appetite was bad till the seventh day, when it improved.

Heart was healthy till the fifth day, when a slight systolic basic murmur was heard. This disappeared between the twenty-second and twenty-seventh days.

The child was slightly delirious on the nights of the second and third days.

The urine was examined daily. It never contained any albumen.

General appearance.—The child never appeared at any time at all oppressed by the fever.

Diet.—May 26th, beef tea 1 pint, milk 1 pint, wine 4 oz. 28th, omit wine. 31st, pudding diet, milk 1 pint. June 4th, broth diet. 10th, meal diet.

The child was admitted on the second day of the disease.

On the second day of the disease the temperature rose to $102\frac{2}{5}$; on the third, 102; on the fourth, $100\frac{1}{5}$; on the fifth, $99\frac{2}{5}$; and continued to rise daily to this last temperature till the tenth, when it only reached 98.

Table giving the daily amount of urea, chloride of sodium, and urinary water.

Day of disease.	Urea.	NaCl.	Water.
	Grammes.	Grammes.	
Third	9·112	0·798	225 c.c.
Fourth	9·100	0·900	200
Fifth	6·075	0·911	135
Sixth	8·997	1·982	305
Seventh	6·090	1·450	290
Eighth	6·772	1·827	315
Ninth	Lost		
Tenth	7·680	2·400	480
Eleventh	7·695	2·025	450
Twelfth	7·905	2·325	405
Thirteenth	9·625	4·012	535
Fourteenth	10·875	4·350	580
Fifteenth	7·800	2·640	480
Sixteenth	8·407	2·075	415
Seventeenth	8·797	3·191	345
Eighteenth	8·400	3·990	420
Nineteenth	8·062	3·082	375
Twentieth	10·500	5·250	700
Twenty-first	11·812	3·370	375
Twenty-second	9·360	2·470	260
Twenty-third	11·000	3·212	440
Twenty-fourth	12·255	4·827	645
Twenty-fifth	11·115	3·700	390
Twenty-sixth	11·375	4·225	650
Twenty-seventh	12·670	4·870	650
Twenty-eight	12·420	3·510	540

Case 11.—George Gibbs. No note was made of the date of the commencement, but merely of the day on which the rash appeared; this I have assumed to be the second day.

The rash disappeared on the eighth day; desquamation began on the eighth day, and was mostly completed on the twenty-seventh day. Some still remained on the feet and ankles till the thirty-ninth, and on the soles of the feet till the forty-seventh day.

Glands.—At the angles of the jaw they were enlarged; began to diminish on the eighth day, but were still somewhat enlarged on the thirty-first.

Groins, here they were so much enlarged as to be visible; they began to diminish on the ninth day, but were still spotty on the thirty-first.

Urine.—No albumen before and on the eleventh day; slight cloud on the twelfth; increased in quantity on the thirteenth; slight cloud from the fourteenth to the sixteenth inclusive; none on the seventeenth; none till the twentieth, on which day a large quantity was discovered. Still more albumen, urine smoky, on the twenty-first; albumen less, rather smoky, on the twenty-third; much more smoky on the twenty-sixth; very smoky, less albumen, on the twenty-seventh and twenty-eighth; less smoky on the twenty-ninth and thirty-first; not smoky, a slight cloud of albumen, on the thirty-fourth; very slight on the thirty-fifth; smoky, rather dense cloud of albumen, on the thirty-sixth and thirty-seventh; albumen less on the thirty-eighth; not smoky, and only slight cloud of albumen on the thirty-ninth and fortieth, and continued so to the forty-sixth day.

General condition.—Progressed favorably till the night of the eleventh, when he complained greatly of pain in the left ear, which continued during the twelfth day. Was puffy about the face, and pitted over the forehead on the twenty-second. This increased somewhat till the thirty-first day inclusive, and then declined.

Temperature.—On the second day of the disease the temperature reached to $102\frac{4}{5}$; on the third, $103\frac{3}{5}$; on the fourth, $101\frac{2}{5}$; on the fifth, $99\frac{3}{5}$.

It continued to rise daily to this point till the eleventh day, when it rose to 101. From the twelfth to the seventeenth days inclusive it never rose higher than $99\frac{3}{5}$.

The temperature was not taken on the eighteenth and nineteenth, but on the twentieth day it reached to $105\frac{1}{5}$; on the twenty-first, $99\frac{3}{5}$; on the twenty-second, $101\frac{1}{5}$; on the twenty-third, $99\frac{3}{5}$.

It then continued at about 99 till the twenty-sixth day

when it again rose to $103\frac{2}{5}$. From the twenty-seventh to the fortieth day it remained at about 99.

Case 12.—Anu Swinson; height, 3 feet 6 inches; weight, 16·3 kilogrammes. She was admitted for supposed caries of the crest of the ilium. The scarlet fever developed itself whilst she was in the hospital.

On March 25th she had sore throat, and flagged. On the 27th, a doubtful rash was seen. She had no desquamation, and the reality of the nature of the disease was considered doubtful till the renal affection presented itself.

On the nineteenth day of the disease, between 6 and 7 a.m., seized with vomiting and shiverings; the evening before she was pretty well. At the time of my visit she was oppressed, drowsy, very pale, and puffy. She complained of much frontal pain, and had lost her appetite. Pulse 176, respiration 48. Wounds about the ilium looking as before. Lungs were healthy. During the morning she perspired very profusely, and at 12 a.m. her trunk was covered with minute sudamina.

On the twentieth day was much improved; complained of no pain anywhere. Rather drowsy; appetite very bad; pulse 116, very weak; wounds looking much the same. Last night, about 7 p.m., complained of much pain in right foot; there was no redness nor swelling, but it was very tender. This morning there is a deep-red blush over the malleoli, and this part is very tender. Appetite very bad.

On the twenty-first she was less puffy, complained of no pain; pulse 132, feeble. Redness over the right ankle increased in intensity and area; the wounds about the crest of the ilium were looking well; appetite was better than yesterday; less drowsy.

Twenty-second.—Passed a restless night; still rather puffy; ankle more swollen, very red, and painful; pulse 108, weak; lungs healthy; heart, first sound at the apex murmurish.

Twenty-third.—Matter pointing over the outer malleolus; appetite a little better; still puffy looking.

Twenty-fourth.—Much the same; first sound of the heart at the apex dull.

Twenty-fifth.—Swelling extending up the leg.

Twenty-sixth, 3 a.m.—Active vomiting came on, greenish colour, accompanied with diarrhœa; lips and tongue rather dry; soft systolic apex murmur; ankle opened.

Twenty-eighth.—Much thin discharge from the wound at the ankle; redness very much less; no sickness, no diarrhœa.

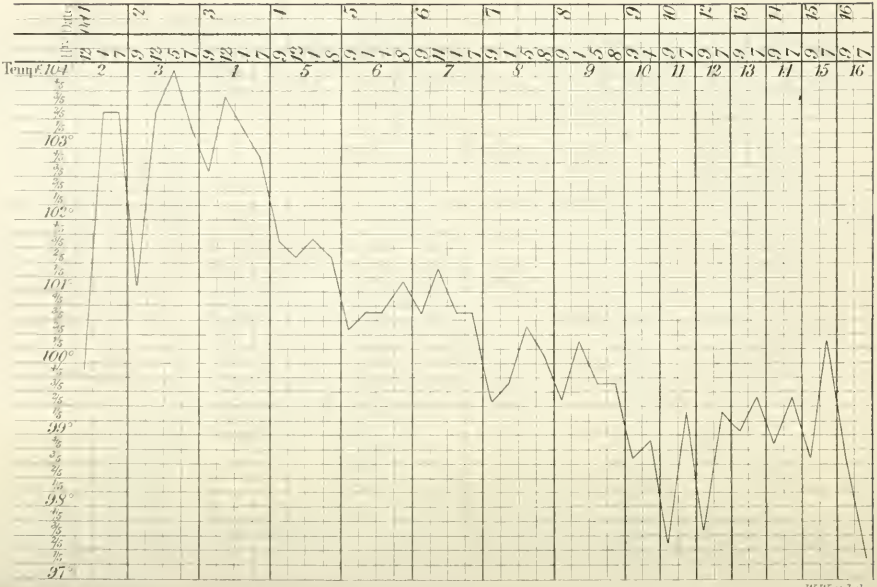
Thirty-first.—Face pasty looking; tongue dry; discharge from ankle less. No pitting of any part of body, except right foot; distinct apex systolic murmur.

Thirty-second.—Decidedly better.

Subsequently active tubercular deposition took place in her lungs.

Urine.	Urea.	Quantity.	Albumen.
5·30, March 27th, to 10 a.m., March 28th	4·779	117	
Fifth day, March 28th and 29th ...	4·720	.....	Shade.
Sixth	3·877	235	Slight shade.
Seventh	5·037	310	Slight shade.
Eighth	6·020	430	Slight shade.
Ninth	7·59	660	Rather more.
Tenth	7·450	745	Shade.
Eleventh	11·325	1175	Shade.
Twelfth	11·325	1175	Shade.
Thirteenth	8·712	1025	Shade.
Fourteenth	9·776	1185	Shade.
Fifteenth	9·150	915	Shade.
Sixteenth	8·085	735	None.
Eighteenth	10·442	585	None.
Nineteenth	7·995	390	None.
Twentieth.—Smoky, red colour	.....	.....	Abundant.
Twenty-first.—Slightly smoky	.....	.....	Very abundant.
Twenty-second	1·875	110	Fills two thirds of the tube.
Twenty-third	0·510	60	Fills two thirds of the tube.
Twenty-fourth.—Albumen much less	.....	85	
Twenty-fifth.—Urine contains casts and uric acid, and also kidney-epithelium.			
Twenty-sixth.—Albumen much more abundant.			
Twenty-seventh. — Albumen much more abundant.			

Case 16. Ellen Kepping.



On the twenty-second and twenty-third days the albumen was removed by shaking up the urine with animal charcoal.

She was readmitted on the seventy-eighth day; the urine still contained abumen.

Temperature.—On the third day the temperature reached $100\frac{3}{5}$; on the fourth, $98\frac{3}{5}$; on the fifth, $98\frac{3}{5}$; on the sixth, $98\frac{1}{5}$; on the seventh, $100\frac{1}{5}$; on the eighth, $100\frac{1}{5}$; on the ninth, $100\frac{2}{5}$; on the sixteenth, 99; on the seventeenth, 97; on the eighteenth, $98\frac{3}{5}$; on the nineteenth, 105; on the twentieth, 100; on the twenty-first, $101\frac{3}{5}$; on the twenty-second, $103\frac{1}{5}$; on the twenty-third, $101\frac{4}{5}$; on the twenty-fourth, 102; on the twenty-fifth, $100\frac{2}{5}$; on the twenty-sixth, $100\frac{4}{5}$; on the twenty-seventh, $101\frac{4}{5}$; on the twenty-eighth, $102\frac{1}{5}$.

Case 13.—Charles Ebett, æt. 3 years 9 months. The commencement of the disease in this case was not noted, but merely the first appearance of rash. This I have assumed to be the second day.

This was a very slight case.

Temperature.—On the second day of the disease the temperature rose to $101\frac{2}{5}$; on the third, $99\frac{1}{5}$; on the fourth, $99\frac{3}{5}$; on the fifth, $97\frac{4}{5}$; on the sixth, $97\frac{3}{5}$.

Case 14.—Matilda Browne. The lowest temperature occurred on the fifth day, the temperature falling from $102\frac{3}{5}$ to 100.

Case 15.—Sarah Hewett, æt. 7. She was seized on 7th, shortly after breakfast. The rash appeared on the second day.

The temperature on the third day rose to 101; on the fourth, to 100; on the fifth, to 99.

Case 16 (see Diagram 4).—Ellen Kipping, æt. 11. Seized Monday, September 30th, with vomiting, diarrhœa, anorexia, and complained of sore throat. Rash first noticed on October 1st. It was intensely marked. It had nearly

disappeared from the whole body on the seventh. Desquamation began on the ninth, about the forehead and labia. Tongue was rather furred on the second day, thickly coated on the third; after this it was of the strawberry character to the ninth inclusive; after this no notes were made.

Fauces were vividly red, but not swollen, to the fifth day inclusive, and improved on the eighth.

Conjunctivæ were injected till the seventh day inclusive.

Glands at the angles of the jaw were slightly enlarged; more so in groins.

Urine was tested till the ninth day; on the fifth and sixth there was a slight trace of albumen.

The child was rather delirious during the fourth and fifth nights.

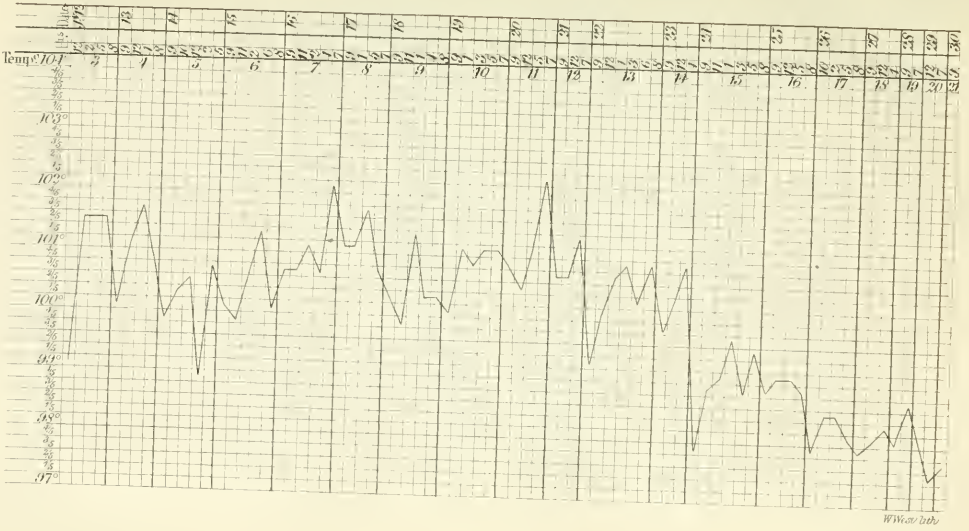
Appetite was very bad till the sixteenth, when it improved somewhat.

This was decidedly a sharp attack. The rash was strongly marked. She was very heavy and prostrate till the fifth day, when she very greatly improved, and then continued to mend.

Case 17 (see Diagram 5).—Maria Hodge, æt. 2 years 2 months. Scarlet fever, urticaria, chicken-pox. The child had an attack of measles three weeks before her admission into hospital. The attack lasted about a week, and then she appeared quite well again. On July 19th was quite well during the day, but was very restless during the night. Next day the rash appeared, and she was feverish and had no appetite. Rash at the time of admission was slight everywhere, but most marked on the legs. It disappeared from the face, chest, and abdomen on the fifth day, and from the legs and arms on the seventh. In this case the rash on the arms and legs was much localized, and caused hard, spotty elevations, some the size of a small pea; it was in these that the rash remained so long.

Desquamation.—Face, none; trunk, none. Legs, appeared on the folds of thighs on the eighth, and disappeared on the ninth. Appeared on the arms slightly on the ninth, dis-

Case 17. Maria Hodge.



appeared on the tenth; on the sixteenth there was some on the palms of the hands.

On the seventh day of the disease a wheal of urticaria was noticed; a few more appeared on the eighth and ninth. They consisted of elevations about the size of peas, pale, semi-transparent, hard, and surrounded by a ring of redness an inch in diameter.

On the seventh a vesicle of chicken-pox was seen on the chest, followed by a few others till the twelfth day inclusive. These, instead of drying up and healing, ulcerated and became surrounded by much swelling. The ulcers began to heal on the fifteenth day.

Alæ of nose became excoriated with a thin, sanious discharge on the seventh, continuing much the same till the thirteenth, when it improved gradually to the eighteenth day.

Tongue thickly coated, red on the third day, then cleaned; papillæ were prominent on the anterior part still on the fifteenth; was normal on the ninth.

Fauces, &c., very red and swollen, fourth and fifth days; still more so, and covered with muco-purulent-looking matter, on the sixth to eighth inclusive. They then improved, and were almost normal on the eighteenth.

Appetite improved on the fourth day, and continued good after the fifth.

Glands at the angles of the jaw were not enlarged; on the third day began to enlarge; on the fourth they increased in size, till the enlargement was visible on the eighth; they then decreased, and were almost of natural size on the eighteenth. In groin they were first enlarged on the fifth day, and continued slightly enlarged till the ninth, after which they were of normal size.

Urine was examined daily till the twenty-ninth day; no albumen was at any time discovered.

The child appeared to be in a very delicate state and the lips were very dry on the third, cracked and swollen on the eighth and ninth; they then improved somewhat.

On the fifth day a decided improvement, however, was noticed; on the sixth, seventh, and eighth, was not so well

again; vomited. She continued very poorly and heavy during the eleventh and twelfth. After this the child improved.

Case 18.—Eliza Cunningham, æt. 7; assumed weight, 16 kilogrammes. The patient was in the hospital for epilepsy at the time of her seizure. On April 24th, at 11 a.m., she complained of headache and sore throat; soon after, she vomited. After this she appeared to be in her usual health till 4 p.m., when she again vomited, and on being undressed to be put to bed the rash was detected.

Thus the rash appeared on the first day, and disappeared on the eighth day.

Desquamation began on the ninth day and had ceased everywhere on the twenty-eighth day, except on the hands and feet.

Eyes were much injected with some muco-purulent-looking discharge from the second to the sixth day inclusive; it then declined, and ceased on the eleventh day.

Glands.—Angles of jaw were enlarged from the second to eleventh days inclusive, then the swelling declined, and disappeared between the twenty-fourth and twenty-eighth.

The glands of the neck were also enlarged, hard, and spotty.

Groins.—A little hard on the second day, enlarged on the third; still more, so as to be visible, during the fourth and fifth; then the swelling declined, and ceased between the twenty-fourth and twenty-eighth days.

Numerous ecchymoses noticed under the clavicles and in groins on the fourth and fifth days.

Some miliary vesicles appeared on the fourth and fifth days.

Sudamina appeared on the eighth day, and were still more numerous on the ninth.

The child was delirious during the night of the first to the fourth inclusive.

Tongue was thickly coated with a creamy fur, the papillæ being prominent on the second and third day. Well-marked

strawberry on the fourth and fifth; it then improved, and was natural on the seventeenth.

Fauces, &c., were very red; on the second day after this the parts improved, and were almost normal on the sixth, continuing, however, a little red and flabby till the tenth.

Heart and lungs healthy throughout.

Pulse was found to be irregular on the twenty-fourth to twenty-eighth days; no other notes made.

General appearance.—Child was heavy and dull on the second day; lips were dry and excoriated on the third; looked better on the fourth day; was decidedly so on the fifth; sat up in bed and played. Then improved till the ninth, when she looked puffy and was rather drowsy. This continued till the twelfth inclusive. After this she improved, though she long continued to be very pale.

There was no albumen in her urine at any time.

Diet.—April 27th, beef tea 1 pint, milk 1 pint, wine 4 oz. May 4th, pudding diet, wine 3 oz. 11th, fish, wine 2 oz.

Temperature.—On the second day of the disease it reached 105; on the third, $105\frac{1}{5}$; fourth, $104\frac{1}{5}$; fifth, $102\frac{2}{5}$; sixth, $102\frac{3}{5}$; seventh, $103\frac{1}{5}$; eighth, $101\frac{1}{5}$; ninth, 101; tenth, 101; eleventh, $100\frac{2}{5}$; twelfth, $99\frac{2}{5}$; thirteenth, $99\frac{1}{5}$; fourteenth, $99\frac{2}{5}$; fifteenth, $98\frac{3}{5}$. It continued at about $98\frac{3}{5}$ till the twenty-third day, after which it was not taken.

Table showing the daily amount of urea and urinary water.

Day of disease.	Urea.	Urinary water.
	Grammes.	
Third	13·950	450 c.c.
Fourth	14·550	485
Fifth	15·240	635
Sixth	8·972	485
Seventh	8·910	810
Eighth	10·290	980
Ninth	5·898	715
Tenth	5·665	515
Eleventh	5·197	385
Twelfth	6·050	550
Thirteenth	4·557	435

Day of disease.	Urea.	Urinary water.
	Grammes.	
Fourteenth.....	6·825	350 c.c.
Fifteenth	7·312	325
Sixteenth	6·195	590
Seventeenth	8·550	450
Eighteenth.....	Lost	.....
Nineteenth.....	10·135	280
Twentieth	10·360	280
Twenty-first	9·350	275
Twenty-second ...	10·767	365
Twenty-third.....	9·657	365
Twenty-fourth ...	10·725	330
Twenty-fifth	11·700	325
Twenty-sixth.....	12·240	360
Twenty-seventh...	9·460	220
Twenty-eighth ...	9·800	245
Twenty-ninth.....	11·812	315
Thirtieth	6·982	245
Thirty-first.....	7·020	390
Thirty-second ...	12·410	730

Case 19 (see Diagram 6, *a* and *b*).—Anne Lynch, æt. 3 years 3 months. On April 28th she had rigors. Lost her appetite, and subsequently was very thirsty.

On April 29th the rash appeared. She never complained of sore throat. The rash disappeared on the tenth day.

Desquamation began on the seventh day; it had mostly ceased on the twenty-fourth, but still continued on the heel on the forty-third day of the disease. It also continued on the palms of the hands till the thirty-sixth day.

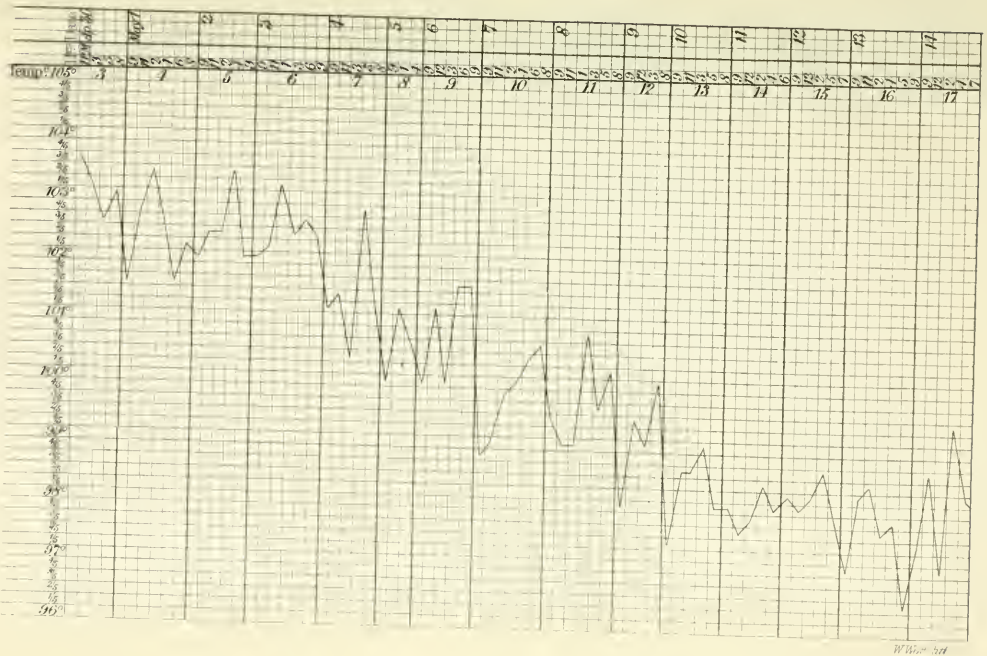
Numerous miliaria were observed over the whole body, except the hands, arms, and feet, on the fourth and fifth days.

Glands at the angles of jaw were rather enlarged on the third and fourth days, and greatly so from the fifth to the eighteenth days inclusive, those on the right side being the most so. They decreased in size from the twenty-second, though on that day they were as large as a chestnut. They were still enlarged on the fifty-first day.

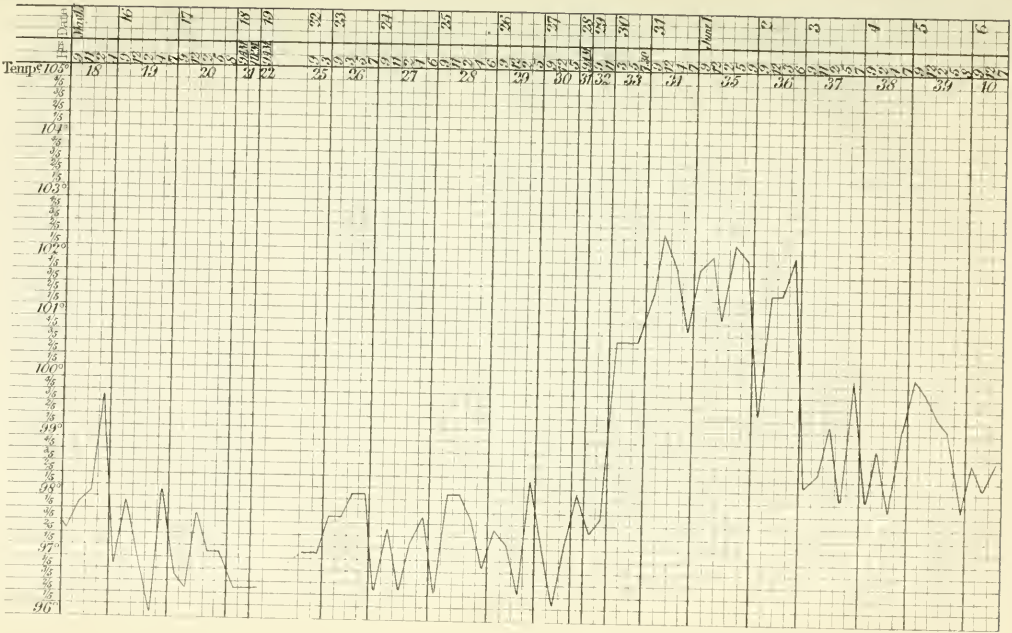
The glandula concatenatæ on both sides were enlarged.

In the groin they were rather enlarged from the third to

Case 19. Anne Leach. No 6A



Anne Leach. *Cont.d*



the twenty-ninth day; after this they decreased, and were normal on the thirty-sixth.

Tongue was red, with prominent papillæ on the fourth. It then improved, and on the eighth and ninth it was pale and smooth. After the sixteenth day it was normal.

Fauces, &c., lividly red; tonsils much enlarged, and covered with exudation; much muco-purulent-looking fluid over the posterior fauces from the third to the ninth day inclusive. They were less red, and some exudation was observed on the posterior surface of the uvula on the eleventh day. The tonsils were so swollen as almost to meet on the thirteenth and fourteenth days. A small ulcer was noticed on the palate from the sixteenth to the eighteenth days inclusive. The swelling diminished in size from the twenty-second, and were almost natural on the twenty-fourth.

Appetite was bad till the fourteenth day inclusive. It was excellent from the eighteenth to the twenty-ninth inclusive. On the thirty-third it was bad again, and continued so on the thirty-fourth and thirty-fifth, after which it improved again.

A discharge from the right ear began on the thirty-sixth, and continued till the forty-third day.

Heart was healthy throughout.

Some sonorous rhonchus heard in the lungs on the fifth day.

There was no pitting of the forehead, sacrum, nor legs, on pressure, at any time.

General appearance.—The child was oppressed till the eighth day. After this she improved, and continued pretty well till the thirty-fourth day, when she became very ill again. She was very drowsy from the thirty-third to the thirty-sixth day inclusive.

Urine was examined daily on the twenty-third for the first time; a distinct cloud of albumen was noticed.

Twenty-fourth.—More abundant.

Twenty-sixth.—Still more abundant.

Twenty-seventh.—After boiling and being allowed to stand, the coagulated albumen filled one third of the tube.

To-day, for the first time examined microscopically, a little blood was found, and some uric-acid crystals.

Twenty-eighth.—Albumen fills one half of the tube.

Twenty-ninth.—Albumen same in amount; urine contained blood; casts waxy and granular.

Thirtieth.—Urine very smoky; albumen about the same; contained blood and casts.

Thirty-first.—Of a red colour, evidently due to blood; albumen the same; contained casts, blood, and uric-acid-crystals.

Thirty-second.—Less smoky; albumen a little less; blood, uric acid, casts.

Thirty-third.—Albumen fills one fourth of the tube. Blood appears to be much more abundant; casts and uric acid.

Thirty-fourth.—Albumen same, judging by the colour and the amount of deposit; the blood much more abundant.

Thirty-fifth.—Same.

Thirty-sixth.—Albumen fell one third of tube; urine still redder; casts, with blood, pus, and kidneys; epithelium imbedded in them, also some free from corpuscles.

Thirty-seventh.—Urine very much better, much less red; deposit of blood much less abundant; albumen occupies about one seventh of the tube; cast and pus-cells.

Thirty-eighth and thirty-ninth.—Ditto.

Forty-first.—Albumen less now, merely smoky, and rather red; albumen fell one twelfth of tube.

Forty-second.—Urine better.

Forty-fourth.—An abundant cloud of albumen; urine still pinkish and smoky.

Forty-sixth.—Not smoky. Rather abundant cloud of albumen.

Forty-seventh.—Much more smoky again.

Forty-eighth.—Blood appears to be much more abundant again. Rather thick cloud of albumen. Microscope—blood-casts and plenty of kidney-epithelium.

Forty-ninth.—Still worse, redder, and brown. Very abundant precipitate of blood. Abundance of urine passed.

Fifty-first.—Still very smoky and red.

Fifty-second.—Still very red, and copious deposit of blood. On boiling did not get a trace of albumen.

Fifty-third.—Ditto.

Fifty-fourth.—Ditto but got a decided cloud of albumen, when urine shaken so as to mix the blood with it.

Fifty-fifth.—Same.

Fifty-sixth.—Decidedly better, scarcely smoky. No deposit of blood.

Fifty-seventh.—Urine still less smoky; amount of albumen greatly increased.

Fifty-eighth.—Not smoky; an abundant cloud of albumen.

Sixty-first.—Not smoky; albumen rather less.

Sixty-third.—Urine abundant; distinct cloud of albumen.

Sixty-fifth.—Again red and smoky, with rather abundant cloud of albumen.

Urine always abundant.

Case 20.—Louisa White; height, 3 feet 5¼ inches; weight, 15·4 kilogrammes. She was in the hospital with a slight attack of chorea, and was discharged on account of the prevalence of diphtheria, but was very soon readmitted with scarlet fever.

She was seized with sore throat on March 12th. The rash appeared on the same day, and on the first day the rash was over the whole body except the feet.

Second day it reached the feet, elsewhere declining. Disappeared from the face on the third day; from the forearm on the fourth; from the legs on the fifth; from the shoulders and all the body, except immediately beneath the clavicles and over the pubes, on the sixth, and on the seventh it had universally disappeared.

Desquamation began on the seventh day on the face and neck; on the eighth day it implicated the entire trunk and arms; on the ninth it began on the palms of the hand; on the fourteenth on the thighs; sixteenth, on the fore legs, and at the same time it was completed everywhere else except on the hands.

Twenty-ninth.—Almost completed on the palms.

Thirty-sixth.—Still desquamating on the soles of the feet.

The conjunctivæ were injected on the first, second, and third days.

Glands (angle of jaw.)—They were rather enlarged on the first day; they increased in size till the tenth day; between this and the twenty-sixth they became normal.

Glands in the groins were much enlarged, so as to be visible, and on thirty-first day were still enlarged.

Glands of neck were also enlarged.

Tongue red, with patches of fur, on the first day. From the second to eighth inclusive it was strawberry; on ninth and tenth day pale, and rather dry. Became moist on sixteenth, and then was a little red, and continued so to thirty-sixth, when it was still smooth in the centre.

Fauces red and inflamed on the first day; increased in size, so that the tonsils almost met, till the third. On the fourth the parts were covered with a tenacious-looking membrane. On seventh, besides the above membrane, there was much muco-purulent-looking fluid. On tenth, tonsils were less swollen; after this declined till on the fifteenth its parts were only slightly swollen and red.

No delirium on the first night. Delirious during the second, third, and fourth nights.

Appetite very bad till the ninth day, when it improved and continued good afterwards.

Lips, nose, &c.—First day sordes on lips; this continued, and on the fifth, lips were drier and the alæ of the nose became red and excoriated. After the eighth day these improved somewhat, but nose continued red and excoriated and the lips dry till the twenty-fifth day.

Choreae movements became worse somewhat on the third, fourth, and fifth days. Much better on sixth, and ceased on the seventh; continued so till the twenty-seventh, when they were slight, and then disappeared again, not returning up to the time of her dismissal. Her movements, however, throughout were awkward.

Child was very ill and did not improve till the tenth day, when a slight improvement was noted, and convalescence after this was very slow till the twenty-eighth day, when a decided improvement was noticed.

No albumen in the urine at any time.

Temperature.—On the tenth day the temperature rose to $103\frac{3}{5}$; on the second, to $103\frac{2}{5}$; on the third, to $102\frac{3}{5}$; on the fourth, to $100\frac{8}{5}$; on the fifth, to $100\frac{3}{5}$; on the sixth, to $101\frac{3}{5}$; on the seventh, to $100\frac{8}{5}$; on the eighth, to $101\frac{3}{5}$; on the ninth, to $102\frac{3}{5}$; on the tenth, to $102\frac{3}{5}$; on the eleventh, to $102\frac{1}{5}$; on the twelfth, to $101\frac{3}{5}$; on the thirteenth, to $99\frac{1}{5}$; on the fourteenth the temperature continued about 99 till the fortieth day.

Table showing the daily amount of urea, chloride of sodium, and urinary water.

Day of disease.	Urea.	NaCl.	Water.
Second	7·370	0·440	220 c.c.
Third	10·650	0·600	300
Fourth	10·608	1·035	345
Fifth	9·800	0·980	280
Sixth	9·300	1·035	345
Seventh	9·300	1·705	620
Eighth	9·347	1·110	370
Ninth	8·200	1·840	400
Tenth	5·880	1·120	280
Eleventh	7·425	1·320	330
Twelfth	.....	Lost.	.....
Thirteenth	7·245	.....	345
Fourteenth	7·065	2·363	305
Fifteenth	4·140	1·350	180
Sixteenth	.....	Lost.	.....
Seventeenth	7·567	.....	322
Eighteenth	5·200	.....	200
Nineteenth	7·227	.....	245
Twentieth	5·565	.....	210
Twenty-first	7·055	.....	415
Twenty-second	7·930	.....	305
Twenty-third	7·287	.....	275
Twenty-fourth	.....	Lost.	.....
Twenty-fifth / Twenty-sixth	11·100	.....	555
Twenty-seventh	5·865	.....	345
Twenty-eighth	6·410	.....	435
Twenty-ninth	7·827	.....	505
Thirtieth	9·067	.....	585
Thirty-first	10·005	.....	435
Thirty-second	8·580	.....	520
Thirty-third	8·100	.....	360
Thirty-fourth	6·743	.....	415
Thirty-fifth	12·610	.....	485
Thirty-sixth	11·760	.....	480
Thirty-seventh	8·500	.....	500

Case 21.—Anne Neil. Rash appeared on the 27th April. No rash at any time on the face.

Chest.—Numerous reddened, elevated papillæ, from the second to the fifth day inclusive. After this it declined, and had disappeared on the ninth.

Abdomen.—Same as on chest, except that it commenced to decline on the fifth, and some slight rash still continued on the ninth day.

Legs the same as the abdomen.

Desquamation.—No note was made on the ninth and tenth days, but on the eleventh it was slight on the chin and chest.

Glands at both angles of the jaw were enlarged slightly on the second day; those on the left side continued slightly enlarged till the thirteenth, when they were normal; those on the right side, after the second day, increased greatly in size, and were still so on the thirteenth. Glands down the neck were also greatly enlarged. In groin they were so enlarged as to be visible. The enlargement commenced on the second and declined on the fifth.

Tongue thickly furred on the second; this cleared off, and left the strawberry tongue on the fourth; this continued till the eighth inclusive; the papillæ then became less prominent, but on the fourteenth tongue was still beefy.

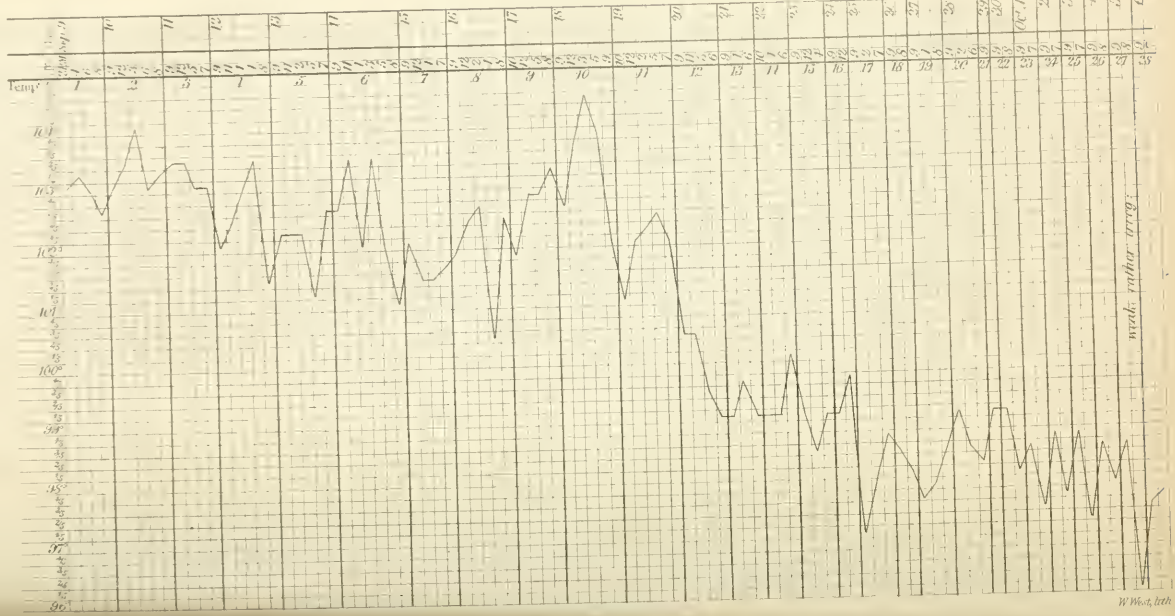
Fauces, &c., very red and much swollen, from the second to fourth inclusive; this was still more marked from the fifth to seventh; on the latter day the parts were very much more red and swollen. On the eighth the redness and swelling began to decline, and the parts were covered with muco-purulent-looking matter. On the thirteenth day they were still swollen and red.

Abundance of sudamina were observed on the chest and abdomen on the second day.

Appetite was rather bad on the fourth day; after this it slowly improved till the eighth day, when it was again bad, but improved on the thirteenth.

The child throughout was in a very low condition. Lips were dry from the first; alæ of nose became red and exco-

Case 22. Margaret Peacock



riated on the sixth, and continued so throughout. Lips were greatly swollen, cracked, and bleeding, on the ninth day; on the fifteenth they were better.

Bowels.—From the fifth to the ninth had three or four liquid motions daily; on the fourteenth day the motions were less frequent.

Child died suddenly on the night of the sixteenth.

Post-mortem.—The lymphatic glands generally of the body were loaded with tubercle, and the small intestines extensively ulcerated. There was old cretified tubercle in the lungs; none of recent origin.

Temperature.—On the second day it rose to $103\frac{2}{5}$; on the third, to $104\frac{1}{5}$; on the fourth, to $103\frac{4}{5}$; on the fifth, to $103\frac{3}{5}$; on the sixth, to $102\frac{3}{5}$; on the seventh, to $102\frac{4}{5}$; on the eighth, to $102\frac{2}{5}$; one the ninth, to 103; on the tenth, to $103\frac{2}{5}$; on the eleventh, to 104; on the twelfth, to $103\frac{3}{5}$; on the thirteenth, $102\frac{1}{5}$; on the fourteenth, $101\frac{2}{5}$; on the fifteenth, $101\frac{2}{5}$; on the sixteenth, $101\frac{2}{5}$.

Case 22 (see Diagram 7).—Margaret Peacock, æt. $5\frac{1}{2}$. Seized at 1 a.m., September 9th. Rash appeared on the same day. She first complained of sore throat on September 2nd, but remained in her usual health till the 9th. Rash was universal on the first, and disappeared on the fifth day.

Desquamation began on the chest, abdomen, and arms on the twelfth day; began on the legs on the sixteenth, and on the same day was completed on the chest; ceased on the abdomen and legs between the twentieth and twenty-seventh days, and still continued on the hands on the twenty-seventh.

Alæ of nose in this case were excoriated.

Conjunctivæ injected from the first to third day inclusive.

Lips were dry and covered with sordes from the first to twelfth day inclusive.

Glands at the angles of the jaw were enlarged on the first, and continued so to the ninth. On the tenth and twelfth the swelling had increased greatly, extending on the

face over the parotid gland; on the thirteenth it began to diminish, but continued to be enlarged even on the twenty-seventh. Glands in groin were enlarged on the sixteenth day; after this no note of their condition was made.

Tongue, rather furred on the first; fur cleared off, but left the tongue dry and brown, on the third; remained so and was cracked till the eleventh day inclusive; on the thirteenth it was moister; on the sixteenth was clean, continuing so afterwards.

Fauces, &c., red and covered with mucus on the first and third; were still redder on the fourth. Redness was less, but swelling more, on the fifth to ninth inclusive; the parts then improved, and were normal on the sixteenth.

Body covered with sudamina on the ninth. Appetite improved on the ninth day.

Lungs healthy throughout.

Heart was healthy on the ninth. No note was made after this till the eleventh, when a distinct murmur was caught, audible at base and apex, most so at the base. It became much less distinct at the apex on the twelfth; the murmur continued throughout.

Never any albumen in her urine.

Child continued very poorly till the ninth day, when she improved, and continued from this time to mend.

Case 23.—Sophia Pattenson, æt. 5½. On September 12th, after tea, she was seized with vomiting and pain in the head. On September 13th the rash appeared; was universal. According to the mother, it declined on the 15th September (fourth day). It disappeared from the whole body on the seventh.

Desquamation began on the face on the seventh; on the chest and abdomen on the eighth; on the legs between the thirteenth and seventeenth days; on the palms on the tenth; was very active on the chest, abdomen, and the arms, on the seventeenth, and was completed on the twenty-first; still continues on the legs and hands on the twenty-fourth day.

Glands at the angles of the jaw were normal till the ninth day, when they became swollen and very painful on the left

side; they decreased in size from the eleventh, but still remained much enlarged on the seventeenth day. Glands in groin were enlarged on the fifth day, and resumed their normal size between the thirteenth and twenty-first days.

Tongue clean throughout.

Throat normal throughout.

Appetite was middling on the sixth day, and improved after this.

Lungs always healthy.

Heart.—A distinct systolic murmur, audible at base and apex, on the eighth; ceased at the apex but continued audible at the base, and was inaudible at either cartilage from the ninth to the thirteenth inclusive. No murmur was audible on the seventeenth nor twenty-first day. No notes were taken in the intermediate days.

No albumen in the urine at any time.

The child was cheerful on the fifth; on the sixth became heavy, drowsy, and fretful, passed a restless night on the eighth. After the ninth day she improved again rapidly.

Temperature.—On the fifth day it reached 100; on the sixth, $99\frac{2}{5}$; seventh, $99\frac{4}{5}$; eighth, $104\frac{1}{5}$; ninth, $103\frac{1}{5}$; tenth, $102\frac{2}{5}$; eleventh, $102\frac{2}{5}$; twelfth, $102\frac{3}{5}$; thirteenth, 100; fourteenth, $98\frac{3}{5}$; fifteenth, $98\frac{2}{5}$. It remained at about 98 till the twenty-fifth day.

Case 24.—Mary Hugden, æt. 11; weight, 25·5 kilogrammes. Patient was seized with sore throat on November 23rd; rash appeared on the 24th. Rash was well out and universal till the seventh day inclusive; then declined, and, on the tenth, there was a mere trace.

Desquamation began on the face on the seventh; began on the hands on the ninth; on the twelfth it was universal.

Tongue was dry and glazed on the seventh; moister, eighth and ninth.

Sweated profusely on the night of the eighth and ninth.

Appetite improved on the tenth.

Observations were then discontinued till January 22nd (sixty-first day). During this interval she had much blood

and albumen in the urine. On the sixty-first day she was very pale, scarcely any anasarca.

A small amount of albumen occurred in the urine from the sixty-third to sixty-eighth days inclusive; after this the urine was not examined.

The temperature in this case was not taken after the twelfth day; from the fifth to the twelfth days inclusive the temperature varied between 103° and 104°.

Table giving the daily amount of urea, NaCl, and urinary water.

Day of Disease.	Urea.	NaCl.	Water.
	Grammes.		
Sixth	17·550	3·565	1486 c.c.
Seventh	18·487	4·006	2175
Eighth	15·200	2·968	2375
Ninth	13·450	2·220	1850
Tenth	14·437	1·788	1875
Eleventh	14·265	1·902	1585
Twelfth	15·096	2·294	1480
Thirteenth	10·400	0·357	650
Sixty-third	6·570	.....	595
Sixty-fourth	6·864	3·630	660
Sixty-fifth	9·086	4·543	770
Sixty-sixth	6·420	.....	600
Sixty-seventh	5·050	2·127	370
Sixty-eighth	7·155	3·445	530

Case 25.—Emma Walsham, height, 4 ft. 1½ in.; weight, 23·6 kilogrammes. Sore throat noticed on April 3rd; rash appeared on the third day. She came under notice on the sixteenth day of the disease. On that day there was copious desquamation over the neck; on the eighteenth day it involved the chest, abdomen, and thighs; on the twenty-first it began on the palms of the hands; on the twenty-eighth it had ceased on the arms; on the thirty-second it was completed on the chest; also on the abdomen on the thirty-sixth. On the thirty-ninth desquamation only

observed on the feet, and here it was still continued on the forty-fourth day.

Tongue was pale, and some of the papillæ rather prominent when admitted.

The glands at the angles of the jaw reached their normal size between the twenty-ninth and thirty-ninth days. On the forty-fourth they were still shotty in the groins.

Heart and lungs healthy throughout.

On the twenty-seventh day the child was noticed to be puffy about the face (she had been up for several days); twenty-eighth, kept in bed; puffy about eye, and continued so. On the thirty-first day was very feverish, and, during the night, she was delirious.

Urine.—Seventeenth day.—No albumen.

Eighteenth.—A shade.

Nineteenth to twenty-sixth inclusive.—No albumen.

Twenty-seventh.—A shade.

Twenty-eighth.—More distinct; no blood.

Twenty-ninth.—Ditto, ditto.

Thirtieth.—Distinct cloud of albumen. Some blood detected by microscope.

Thirty-first and thirty-second.—No albumen. Some blood detected.

Thirty-fourth.—Smoky, but scarcely a trace of albumen.

Thirty-fifth.—Slightest cloud of albumen. Blood less.

Thirty-sixth.—No albumen. Blood less.

Thirty-seventh.—Slight trace of albumen. Some blood.

Thirty-ninth to forty-first inclusive. No albumen, but blood-discs seen.

From forty-second day to time of dismissal, no blood nor albumen.

Temperature.—The patient was admitted on the sixteenth day of the disease; from this date till the twenty-seventh day inclusive, it remained normal. On the twenty-eighth, it rose to 100; on the twenty-ninth, to $104\frac{2}{5}$; on the thirtieth, to $98\frac{2}{5}$; and, on the thirty-first, to $99\frac{3}{5}$. After this it continued between 98 and 99 till the forty-sixth day.

Table giving the daily amount of urea and urinary water.

Day of Disease.	Urea.	Water.
	Grammes.	
Seventeenth	7·875	750 cc.
Eighteenth.....	15·360	960
Nineteenth.....	Lost.	...
Twentieth	13·322	730
Twenty-first	12·320	880
Twenty-second ...	11·000	500
Twenty-third.....	12·247	710
Twenty-fourth ...	11·870	625
Twenty-fifth	14·550	430
Twenty-sixth.....	13·120	410
Twenty-seventh...	12·905	445
Twenty-eighth ...	12·200	610
Twenty-ninth.....	11·560	680
Thirtieth	11·505	885
Thirty-first.....	13·037	745
Thirty-second ...	9·955	610
Thirty-third	11·407	585
Thirty-fourth.....	12·800	800
Thirty-fifth	10·406	925
Thirty-sixth	14·899	908
Thirty-seventh ...	13·680	1140
Thirty-eighth.....	12·325	850
Thirty-ninth	14·700	700
Fortieth	15·505	585
Forty-first	15·502	385
Forty-second	16 065	595
Forty-third.....	17·381	675
Forty-fourth	16·500	600
Forty-fifth	13·870	730

Case 26 (see Diagram 8). — Mary Anne Dall, æt. 2 years 2 months, was first seized at 5 p.m. of Sept. 11th. Rash appeared on the afternoon of Sept. 12th.

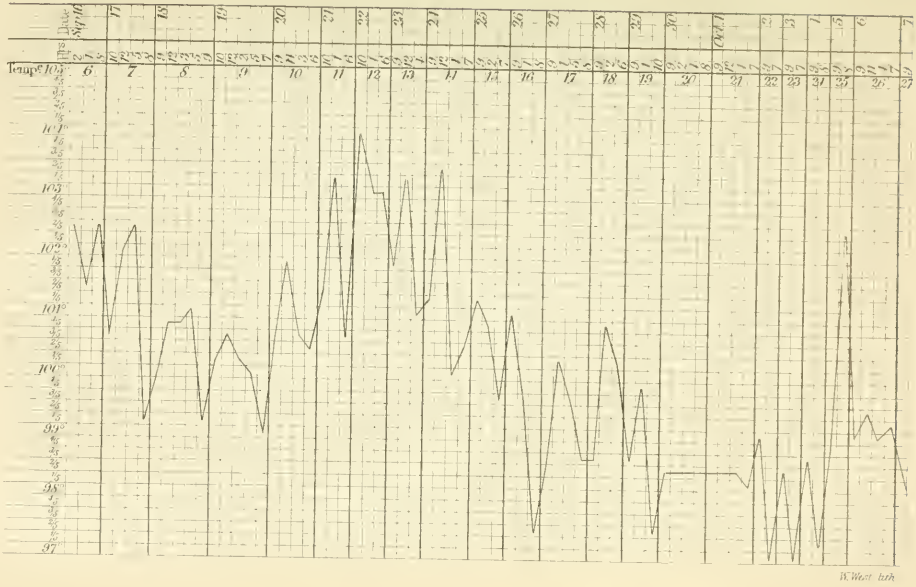
At the time of admission there was a slight rash over the whole body, papilliform; this left the chest on the eighth day; abdomen, leg, and arms, on the seventh.

Glands at angles of jaws and groins, were slightly enlarged, till the tenth day inclusive.

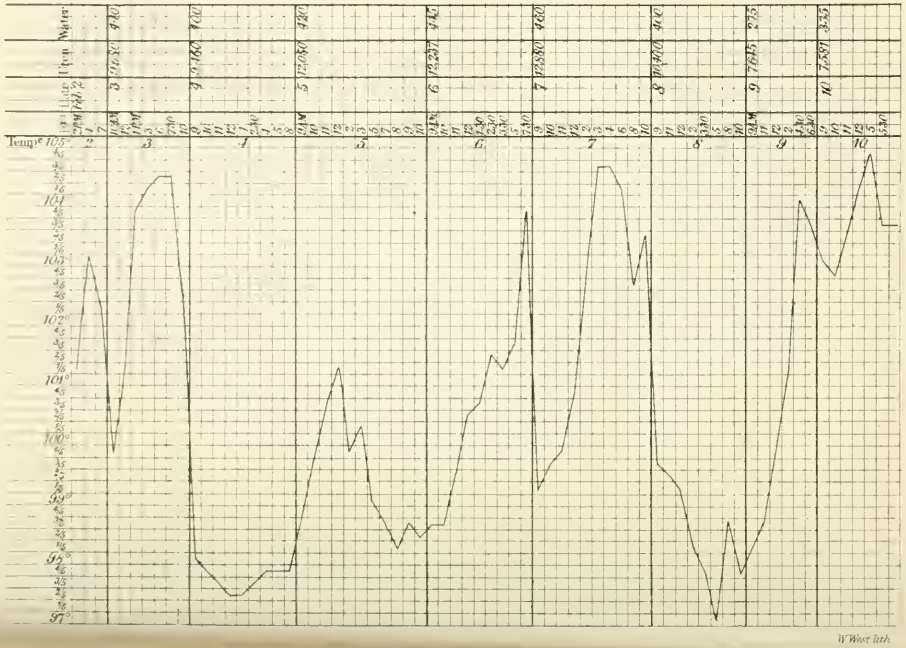
The throat was red and swollen on the sixth, after this it improved, and was much better on the tenth.

Tongue was furred on the seventh, clean on the eighth day.

Case 26. Mary Ann Dally



Case 29. James Kelly. *Æt 9 years. 4 months.*



Heart and lungs were always healthy.
No albumen in the urine at any time.

Case 27.—Mary Wright, urine never contained any albumen. Child died on the fourth day of the disease.

Temperature.—On the second day, it rose to $104\frac{1}{5}$; on the third, $104\frac{3}{5}$; on the fourth, $104\frac{3}{5}$.

Case 28.—Mary Clarke, æt. 5 years 3 months. July 9th, in the morning the child was chilly, in the evening she complained of headache.

July 11th, rash first noticed.

Rash was strongly out over the whole body, till the sixth day inclusive, then diminished, and disappeared from the legs and arms on the eighth, and on the same day it was very slight on the rest of the body.

Miliary vesicles appeared on the fourth day, increased in quantity till the sixth inclusive, occurring on neck, chest, abdomen, and thighs. All trace of them was gone on the seventh.

Child vomited several times a grass-green coloured matter on the fourth and fifth, none on the sixth.

There was no albumen in the urine at any time. Was first delirious on the night of the fifth, this continued nightly till time of her death. She had a very putrid smell on the eighth day. Died on the eighth day.

The temperature throughout varied between 103° and 105°.

Case 29 (see Diagram 9).—James Kelly, æt. 9 years 4 months, admitted Feb. 2nd; ill first, Jan. 27th.

Feb. 3rd.—Slept excellently; pulse much better, tongue still furred; puffy about face; legs pit slightly, very distinct cloud of albumen in urine removed by two grammes of animal charcoal. To-day he had a muco-purulent discharge from nose.

4th.—Hot air bath $\frac{3}{4}$ hour, perspired freely, albumen in

urine same, uric acid, various shapes, globular, lozenge, some casts.

5th.—Much better; warm bath five minutes.

6th.—Wishes to get up, urine uric, no casts, albumen.

7th.—Not so well, appetite less, legs pit on pressure, very puffy about face, much more albumen in urine; hot air bath 6 p.m., perspired greatly.

8th.—Says he feels better; tongue thickly furred, very puffy about face and eyes, quantity of albumen in urine much increased; hot air bath 6 p.m., *in as usual*, half an hour; perspired freely.

9th.—Decidedly less albumen in urine, more puffy about face.

10th.—Face and legs certainly much more œdematous, nothing so well to-day; drowsy.

12th.—Very sick; 2·30 foamed at mouth, groaned, face distorted into numerous grimaces, passed his fæces and urine, and had twitching of arms. Fit lasted quarter of an hour; he never became conscious, fit returned in twenty minutes.

5 p.m. Unconscious; eyes open, foaming at mouth, groans occasionally; hot air bath, and mustard poultice over his loins.

5·20. Another fit; fit continued till 8 p.m.; he died at 12·20 p.m.

ON

PULSE-BREATH.

BY

C. RADCLYFFE HALL, M.D., F.R.C.P.,

PHYSICIAN TO THE HOSPITAL FOR CONSUMPTION, TORQUAY; AND TO THE ERITH HOUSE INSTITUTION FOR REDUCED GENTLEWOMEN AFFECTED WITH DISEASES OF THE CHEST.

COMMUNICATED BY

W. JENNER, M.D.

Received Jan. 9th.—Read Feb. 11th, 1863.

The term pulse-respiration is often used to designate the ratio which exists between the frequency of the pulse and the number of the respirations in a given time. By the term "pulse-breath," I wish to signify something quite different—namely, an audible pulsation communicated to the breath as it issues from the mouth by each beat of the heart.

In some cases of long existing valvular disease of the heart the characteristic morbid sound, whether rasping, or soft and musical, is audible at a certain distance from the patient at all times, provided perfect silence be observed. And in a still larger number of cases of this class the morbid sounds, which at other times are inaudible without close examination of the chest, are occasionally to be heard at a short distance from the patient, when from any cause the action of the heart happens to be unusually excited. And in chronic phthisis, when the stethoscope is placed over a

tolerably empty cavity situated sufficiently near to the heart to receive the impulse of its beat, the amphoric clearness with which the cardiac sounds are heard is familiar to all experienced auscultators.[1] But the sound to which I seek to direct attention has no connection with any cardiac murmur, nor with any abnormal pulmonic sound. It is simply an audible pulsation of the breath as it issues from the patient when he holds his mouth open and breathes as gently, and with as little of the ordinary noises of respiration, as possible. The sound is that of a gentle gushing of the breath, synchronous with each pulsation of the heart, and such as any one may imitate voluntarily so far as the character of the sound is concerned. The degree of audibility varies in different cases, and in the same case under varying circumstances. I have heard it so loud that I could count the pulse by it at a distance of fifteen feet, and so subdued as to need listening close to the patient's face for its detection.

The first case in which I noticed this phenomenon was that of a Somersetshire gentleman, in 1851 (Mr. L—, of Stapleton), who had been, until leaving for Torquay, under the care of Dr. W. Budd. He was phthisical, and had a very large cavity coming to the front in the upper lobe of the left lung. All the characteristic stethoscopic signs—gurgling, splashing, metallic tinkling, cracked-pot sound, cavernous respiration and voice, were present to a marked extent at different times, according to the fulness or emptiness of the cavity; but on rare occasions I also found this phenomenon of "pulse-breath," so that I could count his pulse by it when I was sitting opposite to him.

On the first of these occasions the patient had been a good deal hurried by an attack of vomiting, and I therefore

[1] Walshe on 'Diseases of the Lungs,' 3rd ed., p. 415, § 1370. A work almost mathematical in the concentrated attention which it requires, and in the minuteness, exactness, and completeness of the knowledge with which it repays it.

found him under the two conditions of cavity cleared of its liquid contents, and circulation excited. On my next visit the sign was not present. On every future occasion on which I heard the "pulse-breath" in this patient, the cavity was empty. When the phenomenon was not present, the cavity contained more or less of liquid. This patient died in the last stage of phthisis, from pericarditis.

The second case of phthisis in which I observed "pulse-breath," was that of a Shropshire gentleman (Mr. B—), who had a large excavation in the left lung, adjoining the base of the heart. During the stage of softening, in 1857, this patient came under the notice of Dr. Cotton. His lung broke down after his coming to Torquay, in the winter of 1857. Previously to excavation moist crackle was universal throughout the left lung, but gradually subsided after the formation of the cavity. Since the cavity has become old and its walls condensed—it is now the size of a Seville orange—I have, from time to time, observed the "pulse-breath," but never to so marked an extent as on one occasion, when I happened to visit Mr. B—, after he had had an accidental attack of vomiting. Whilst the patient stood still, with his mouth slightly open, and breathing quietly, I retreated from him until I had reached a distance, by measurement, of fifteen feet, and was able, anywhere within that limit, to count his pulse by listening to his breath—not to his *breathing*—for that of course had a different rate, but to the "pulse-breath." Indeed the sounds of respiration could not be heard nearly so far from the patient, being intentionally kept by him as noiseless as possible.

The mechanism of the production of the phenomenon in these cases seems to be very evident. A large cavity old enough to possess walls of sufficient density, which is not immediately separated from the heart by permeable or crepitating lung, or any other intermediate soft texture which could act the part of a damper, and which is tolerably dry

for the moment by being emptied of its customary contents, vibrates in accordance with each beat of the heart, and at each vibration throws the air in the cavity, trachea, larynx and mouth, into a sonorous pulsation. When the cavity is more or less filled with liquid, it no longer vibrates; and as this is the habitual state of a cavity which has not collapsed, the phenomenon of "pulse-breath" is not ordinarily present even in such cases as can manifest it under fitting conditions.

Such a cavity as will produce the cracked-pot sound in perfection, provided it be sufficiently close to the heart, might, *à priori*, be expected to furnish an example of "pulse-breath."

But my next example is one less easy of explanation.

A Northamptonshire gentleman (Mr. L. R—), æt. 45, who was of such herculean build and stature that he was accustomed to astonish his friends in Paris by the large girth of the calf of his leg, who was fond of all active sports, and was in the habit of hunting three or four days a week without feeling fatigue,—on one occasion, about three years ago, when returning from hunting, was almost too late for his train, and ran too far and too fast, being stout and of full habit at the time. On reaching the railway carriage much out of breath, he felt overcome and faintish. From this time, having previously enjoyed excellent health, he dates a series of slowly increasing ailments.

At different times this gentleman came under the notice of the late Dr. Addison, of Drs. Gairdner, Tyler Smith, Sibson, Francis, Williams, Jenner, and Symonds.

The case is one of cardiac disease with enlarged liver, pulmonic congestion, leaky kidneys, general anasarca of lower extremities, sometimes œdema of genitals, and occasional slight attacks of gout.

A soft, systolic, mitral bellows-sound, is the only morbid bruit, but the extent of cardiac dulness is increased towards the sternum, and although there is no pulsation of the

jugular veins, it is probable that all the cavities of the heart have undergone some amount of dilatation.[1] In front of the upper lobe of the left lung there is dulness and defective respiration. No other morbid change is observable in the breath-sounds, both inspiration and expiration being soft, and as dry as is compatible with softness. There is occasional hæmoptysis, never exceeding a few ounces, and occurring once in two or three months. A good deal of dyspnœa and of blueness of lips and cheeks occurs on exertion or on exposure to cold. Legs bronze-coloured below the knees, from capillary congestion and minute ecchymoses.

[1] The considerable degree in which the systemic circulation suffers is scarcely explicable without assuming that the right side of the heart participates in the affection. Does not the absence of jugular pulsation, in cases such as this, support Dr. Parkes's view, that a yielding of the valves where those veins join the subclavians is essential to the production of jugular pulsation? The slightness and softness of the mitral bruit in a case like this, where the general condition indicates very considerable faultiness of action—whereas in other cases we may have a *loud* bellows-sound, or a sharp, rasping bruit, with almost no systemic disorder for many years—seems to imply that the loudness of the bruit is by no means a criterion of the degree of valvular insufficiency. It is possible (though not proved) that the quality of the morbid sound rather indicates the nature of the valvular morbid alteration than the amount. Thus, a rough sound may possibly imply roughness of surface from puckering of valve, or from concretion. But the converse does not hold good. A smooth murmur by no means of necessity implies that the faulty valve has a smooth surface. Nor does a slight and soft murmur imply that there is only a slight and trivial inadequacy of valve. Nor, on the other hand, does a loud bruit imply that there must be very considerable inadequacy. Loudness of murmur is promoted by thinness of blood, thinness of walls of thorax, and thinness of walls of heart; also, by a jerking character of the heart's systole. None of these conditions are present here. Perhaps the most common case in which the heart is gravely diseased, and yet presents little or no morbid sound, or only a slight "whiff" occasionally, when the action of the heart happens to be unusually forcible, is that of mitral constriction not yet admitting of reflux, with weak heart, and large, bulky body. In the case before us, Dr. Jenner was of opinion that the dropsy must be looked upon as not being entirely due to the primary cardiac disease, but in part also to the secondary renal affection.

Occasionally there is some albumen in the urine, but this may remain absent for a month at a time, or longer. Once in three or four months a moderately smart attack of gout habitually occurs in one of the œdematously swollen feet.

In this patient a soft, gentle "pulse-breath" is *never* absent when the mouth is held open. It is audible when the patient is asleep, and during waking hours is rendered considerably louder when the action of the heart is unusually excited.

The origin of the disease seemed to me to consist in straining of the mitral valve by the forcible running after the railway train, when the body from plethora was in a bad condition for such sudden exertion. In this view Dr. Jenner coincided.

A person in health by running until he is out of breath, may sometimes occasion in himself the phenomenon of "pulse-breath" to a slight extent. But this observation upon one's self is somewhat obscured by the fact that any one, under such circumstances, can hear very plainly the sounds of his heart conducted to his ears through the solid structures of his body. In every case of tuberculized lung some portion of the lung must be more or less densified. To test whether mere densification of lung would occasion the phenomenon, I examined sixteen females and twenty males affected with phthisis in its less grave degrees. Some had small cavities, the majority had not; but all had morbid, moist sounds of some kind. "Pulse-breath" was not noticeable in any. To test whether the same would be the case if the circulation were excited, seventeen of the males obliged me by walking briskly for a mile and a half, and then again submitting to examination. Every variety of croak, wheeze, whistle and click, was to be heard when the patients held their mouths open, but in none the "pulse-breath." Three then ran until they were as much out of breath as seemed to be prudent, and were again examined, and with the same result. Hence, so far from tubercular densification of the lung, *per se*, favouring the production of this sign, an amount of excited cardiac action which would

perhaps occasion "pulse-breath" when the lungs are healthy, fails to do so when the lung is tuberculized, at all events in the stage in which morbid, moist sounds exist. In a healthy person, the air-passages become drier after rapid exercise, and may so be rendered able to make sonorous vibrations upon the contained air in answer to the heart-stroke which is communicated to them through the blood which distends the over-filled pulmonic vessels. In the tuberculized lung there is less of vessel-capacity, and an amount of moisture in the air-passages which can effectually damp their vibrating sufficiently to affect the breath.

"Pulse-breath," then, appears to be due either to the impulse of the heart communicated directly to an empty pulmonic cavity, or to the same impulse conveyed through the blood-vessels to the air-cells and passages.

In the excavation variety, the essential conditions seem to be, that a cavity of sufficient size and firm walls shall be situated sufficiently near to the heart to receive its impulse directly; and that the cavity shall be sufficiently empty to throw the air which it contains into a sonorous pulse, which becomes audible if the mouth be kept open; just as an india-rubber bottle, with a tube in it, might be made to expel its contained air in rhythmical gushes if struck on the outside in a rhythmical order.

If this be so, the phenomenon will not be presented unless the cavity is sufficiently free from moist contents; and so far this corresponds with observation.

In the non-excavation variety, we have in the case before us (1) an enlarged, morbidly solid, and resistant liver, which, if it exercise any influence whatever in producing the phenomenon, can only do so by rendering the diaphragm a more unyielding floor to the thorax, and so favouring the production of pulmonary sounds. Probably it has no influence in the matter. (2.) We have an enlarged heart, of which, at every beat, the right ventricle is pushing blood forwards into the lungs, and the left ventricle through its regurgitant mitral orifice pushing blood backwards into the lungs. These

two forces, acting in opposite directions, meet at the same moment in the blood-vessels of the pulmonary air-cells and tubes, and intensify each other in the common result of making an impulse. Could we see what goes on, we should perceive that the pulmonary arteries pulsated, which is normal; and perhaps that the pulmonary veins pulsated too, which would be abnormal. In any case, the result of the habitual engorgement of the entire circle of pulmonic vessels is that either such a refluent pulsation from the left heart meets the onward pulsation from the right heart, or else that the congestion of the pulmonary veins so checks the circulation as to render the pulsation of the pulmonary arteries sufficiently manifest on the air-cells and tubes to produce a sonorous pulse in the air which they contain. (3.) We have an habitually distended condition of both auricles, which being augmented at each systole of the ventricles, may perhaps impart directly the impulse of the heart to the persistently densified upper lobe of the left lung, and by so doing occasion a vibration of the air contained in its tubes at the same instant of time as the pulse is communicated through the blood-vessels. Whether the existence of some such pulmonic condensation is essential to the production of the cardiac variety of "pulse-breath," I am not at present aware. The nature of the condensation in this instance is probably that it consists of some simple exudation, and of local hyperæmia, which relieves itself by the occasional hæmoptysis. There is no moist secretion in this or in any other part of the lungs, to "damp" the sound. It would be interesting to learn whether if the bronchial tubes became copiously moistened with secretion, the phenomenon would still be presented.

Although in each of the two varieties of "pulse-breath" both heart and lungs are concerned, yet the excavation variety may be designated pulmonary, and the other cardiac. The pulmonary variety will be occasional only, so long as the cavity on which it depends is sometimes full, sometimes empty. The cardiac variety will be constant, provided the

air-passages remain sufficiently dry. In each, the phenomenon will be intensified in proportion to extra-action of the heart.

I am not aware that the sign possesses any especial diagnostic or prognostic importance. When present, the nature of the case will probably, in every instance, be sufficiently evident without it. A case is barely supposable in which "pulse-breath" might be the first thing to attract attention in a person not previously known to have anything wrong in heart or lungs.

Amongst medical friends I have not met with any to whom the phenomenon above described was previously known. And I have not found any allusion to it in books.

ON

BRASS-FOUNDERS' AGUE.

BY

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During a brief holiday visit to Birmingham in the autumn of 1858, I devoted my leisure to visiting the workshops of the various workers in metal, for which that town is famous, with the view of endeavouring to determine whether any causes connected with its manufacturing industry could account for the very large mortality from pulmonary disease among its inhabitants. While visiting the brass-founders' shops, I learned that this class of operatives are liable to suffer from a well-defined form of ailment, known among themselves by the name of ague, and to which I have therefore applied the term "Brass-founders' Ague" at the head of this paper. Since that time I have also had the opportunity of making further inquiries on the subject among brass-founders in Wolverhampton, Sheffield, and Leeds, and likewise on two subsequent occasions in Birmingham. Although I have not been able to pursue the investigation so fully as might have been done by some medical man resident in Birmingham, yet as no one else has taken up the subject, I trust the result of my inquiries may be thought sufficiently interesting to justify their being communicated to the Society.

After completing my own researches I found that Thackrah has mentioned this disease of brass-founders in his admirable 'Essay on the Effects of Arts, Trades, and Professions, on Health and Longevity,' published somewhat more than thirty years since; but he does not appear to have followed out the inquiry, his only notice of the subject being contained in the following passage:—"The brass-melters of Birmingham state their liability also to an intermittent fever, which they term the brass-ague, and which attacks them from once a month to once a year, and leaves them in a state of great debility. As a preventive, they are in the habit of taking emetics."

Several French physicians have noted the occurrence of symptoms analogous to those spoken of by the brass-founders of this country, among the same class of operatives in France; but though the facts related are in perfect accordance with those elicited by my own inquiries, the subject is left in the greatest uncertainty by the latest French writer with whose works I am acquainted. M. Blandet, in a communication to the Academy of Sciences, quoted in the 'Annales d'Hygiène publique et de Médecine légale" (vol. xxxiii, p. 462), describes some symptoms to which copper-founders are liable. These hitherto unnoticed symptoms, he says, manifest themselves in the afternoon or on the morrow of the casting-days, and consist chiefly of weariness, muscular pains, oppression, headache, vomiting, and shiverings lasting for three or four hours and terminating in febrile reaction and profuse sweating. These symptoms, he adds, appear to be the result of intoxication from zinc, which enters largely into the composition of bronze, brass, and other alloys of copper. M. Blandet correctly states that this ailment is aggravated by an imperfect draught in the chimney of the furnace, by a contrary wind beating back the smoke into the workshop, by the closing of the latter in cold weather, and by the pouring out of the molten metal in the middle of the workshop.

In a subsequent paper published in the 'Annales d'Hygiène publique et de Médecine légale' (vol. xxxiv, p. 222),

M. Blandet relates the case of M. Edmond Soyez, who, after having been employed in casting an alloy of copper, containing one tenth part of zinc, from 4 o'clock a.m. to 9 p.m., that is to say, during seventeen hours, began at 3 p.m. to suffer from intoxication caused by zinc, commencing with anorexia and a disgust for both solid and liquid food. At 10 o'clock p.m. he felt extreme weariness, and, on retiring to bed, he suffered agonising pains in the shoulders, elbows, and wrists. At 11 p.m. trembling and shivering set in, and lasted until 1 a.m. The teeth chattered, the skin was cold, and the respiration difficult. The lower limbs became painful, and the joints of the toes so powerfully contracted that the patient was unable to extend them. There were also cramps in the legs. Vomiting, at first of yellow, afterwards of green and bitter matters, commenced at a quarter past 11, and continued until 1 a.m., when an entire change occurred; the shivering ceased, the skin became hot, and the face red, and delirium accompanied by noises in the ears, set in. This fever, an hour afterwards, was followed by drowsiness, which lasted until morning. Wearied and feeble the following day, M. Soyez could, nevertheless, eat his food, but he still suffered from headache, and the roots of his hair were excessively tender. During the next night he experienced profuse sweatings, and on the following morning all morbid phenomena had disappeared. A founder who had worked all day with M. Soyez appears to have suffered in the same manner as his master. In a note by M. Guérard, which immediately follows the paper of M. Blandet in the same volume of the 'Annales,' the symptoms experienced by M. Soyez are attributed to cerebral congestion, the consequence of assiduous and long-continued work near to several hot furnaces, and of two hours' vomiting during the night. M. Guérard then proceeds to describe the case of a copper-founder who had suffered on two occasions from symptoms not very unlike those of M. Soyez, but less regular in their course, unaccompanied by the hot stage, and attended by abundant salivation, by continual trembling of the upper extremities,

with inability to grasp objects firmly, and by constipation. These attacks are attributed by M. Guérard to the copious drinking of tepid water, *i. e.* of water kept in the workshop, and consequently warmed by its atmosphere, and he adds that he had more than once witnessed similar results from the intemperate use of watery drinks by persons of very diverse professions. In a still more recent paper, likewise published in the 'Annales d'Hygiène' (vol. xlvii, p. 26), M. Bouchut says that the makers of oxide of zinc for paint suffer from attacks similar to those described by MM. Blandet and Guérard, as occurring among copper-founders when employed in making alloys containing zinc. M. Bouchut says that there are none of the workmen employed in making zinc-paint who have not many times experienced nervous phenomena characterised by nocturnal agitation, with or without fever, but which yet do not prevent them from resuming their work on the following day.

In a still later work, Tardieu's 'Dictionnaire d'Hygiène publique et de Salubrité,' it is stated, as the result of inquiries made by MM. Rayer, Grisolle, and Chevallier, that of the manufacture of zinc-paint exercises no hurtful influence on the health of the workmen, and that, as regards the phenomena described by M. Bouchut, such as weariness, nocturnal fever, headache, nervous agitation, and evanescent intoxication, further experience, which may now be considered definitive, enables us to regard them as altogether chimerical, or, at least, as ill-defined and founded on a false analogy.

As often happens in subjects of this nature, much of the evidence I obtained during my investigation in reference to brass-founders' ague, appeared at first to be of a very contradictory nature. In certain establishments the disease was entirely unknown, while in others almost every caster had repeatedly suffered from it. Indeed, it was only after persevering inquiry, in more than thirty brass-casting shops at Birmingham, besides several in each of the other towns already enumerated, that these apparent contradic-

tions became reconciled, and they now afford the most conclusive evidence relative to the cause of the symptoms from which the casters suffer. These symptoms have, as the name implies, some resemblance to an imperfect paroxysm of ague, but they differ from true intermittent fever in that the paroxysms occur in no regular sequence to one another, but at irregular and uncertain intervals, each paroxysm being, in fact, independent of those which may have preceded or followed it, and distinctly traceable to exposure to the fumes of deflagrating zinc. This is, unquestionably, the efficient cause of the symptoms, though other circumstances, arising either from the peculiar state of the caster or the conditions under which he works, materially contribute to promote or prevent the development of the attack. Brass-casters who have had personal experience of the disease entirely agree in their account of its symptoms, more than seventy of them having described the disorder in almost identical terms. These symptoms are a sense of malaise and weariness, or, as one very intelligent man termed it, *nervousness ;* a feeling of constriction or tightness of the chest, and, in some rare cases, nausea commencing during the afternoon of a day employed in casting, followed towards evening, or at latest when getting into bed, by shivering, sometimes succeeded by an indistinct hot stage, but invariably by a very definite stage of profuse sweating. The sooner the latter follows the setting in of the cold stage, the shorter and milder is the attack, and the less likely is the caster to be incapacitated for work on the following day. Headache and vomiting frequently, but by no means always, accompany the attack, which, at the worst, is ephemeral, and rarely, if ever, prevents the caster from pursuing his occupation; but the attacks are, in some cases, of frequent occurrence, and men engaged in this employment are seldom long-lived, though the ailment which most evidently shortens their days is chronic bronchitis, or, as they term it, *asthma.* Persons who have but lately adopted the calling, or who only work at it occasionally, and regular casters who have been absent from work for a

few days, are reported to be more liable to suffer from this disease than those who work at it continually. The following evidence of individual casters, in illustration of the subject, is selected from a mass of similar information, on account of the intelligence of the men by whom it was given.

Mr. C—, slip-caster, deposes that when he has been absent from the casting-shop for a day or two he is apt to be affected by the fumes of zinc on returning to work. These produce nervousness, or a sensation throughout his whole frame which he cannot describe, but which makes him aware that he is about to have a paroxysm of metal-ague. On returning home, or during the night, he feels nervous, becomes cold, and has chattering of the teeth. The cold sometimes passes into a hot stage, but whether this happens or not, the attack invariably passes off with a profuse sweating. He feels indisposed on the following day, but not incapacitated for work. Persons who have but recently begun to work in the casting-shops always suffer severely from this disease. He has found the use of stimulants during the attack injurious, but milk is decidedly beneficial.

Mr. V— has been a brass-caster for twenty-five years. Often suffers from brass-ague. The attacks commence with a sense of constriction and tightness of the chest, accompanied by cough and nausea. These are greatly relieved, and the attack perhaps cut short, if vomiting supervene. These premonitory symptoms are followed by trembling and chattering with cold, even though close to the fire, subsequently giving place to profuse sweating. On the following day he is quite well. Is, in general, only liable to these attacks after "playing" for a day or two; but sometimes, in foggy weather, when the fumes cannot escape freely from the shop, has suffered from them, even though he may have been working continuously. Milk is found very efficacious, both as a preventive and cure, but gin, tobacco, lobelia, and tartar emetic, are likewise used by the casters as remedies during the attack.

Mr. J—, brass-caster, has had the ague "hundreds of

times," and was selected by his master for my examination, as the most experienced, trustworthy witness in a very large establishment. The attacks, he said, usually come on after being off work for a time. The earliest symptoms are tightness and oppression of chest and shortness of breath, followed, in the evening, by shivering and copious sweating. He feels out of sorts the day after an attack, but is not rendered incapable of working.

Mr. W— says that he is subject to brass-ague, which he has not observed to occur especially after a temporary cessation from work. When about to have an attack, he experiences, during the afternoon, a sense of weariness, attended by aching of the joints and tightness of the chest, with nausea. These are followed in the evening or at night by shivering, which terminates in sweating. He generally employs means to promote sweating, but has found stimulants decidedly hurtful. In heavy weather, when the fumes do not pass off freely, men are more liable to suffer from metal-ague than in clear, bright weather, when the fumes escape rapidly into the atmosphere.

Mr. T—, master brass-founder, describes the ague as beginning with tightness and oppression of the chest, with dyspnœa and loss of voice, followed by shivering, a hot stage, and profuse sweating. These symptoms only occur when the metals are being mixed to make brass, the usual practice in this shop being to cast the brass into ingots or bars, which are remelted as required for use. It is only during the former of these processes, and not when brass is remelted for casting, that he and his men are liable to suffer from metal-ague.

— Farmer, æt. 26, brass-caster during eleven years, has frequently suffered from brass-founders' ague. The paroxysms usually occur after being "at play" (*i. e.* off work), for a day or two. The first sensation experienced is tightness of the chest, followed towards evening, or at bedtime, by trembling and coldness, and, subsequently, by heat and sweating. He is not quite free from discomfort on

the following day. Has found milk useful in preventing an attack.

— Lipper, æt. 33, brass-caster, has frequently had ague, which, for the most part, comes on at night after his return from the casting-shop, and generally when he has been off work for a few days. The symptoms are shivering, followed by a hot, dry skin, and afterwards by sweating. For these attacks he usually takes some hot stimulant, such as gruel with rum in it, to accelerate the sweating stage.

It was stated by several witnesses that brass-founders who survive to old age are liable to suffer from paralysis agitans. Of the correctness of this statement I am unable to speak with certainty. Indeed, the evidence obtained on this subject is by no means conclusive; only one well-marked case of this disease in a brass-founder having fallen under my observation; but I was assured by the manager of an extensive factory in Birmingham where a large proportion of zinc is used in the making of brass, that nearly all the casters in his employ become more or less "shaky." The case referred to is that of a man named Joshua Parkes, æt. 69, who was said to be the oldest brass-caster in Birmingham. He had given up casting for nearly two years before I saw him, in consequence of being afflicted with shaking palsy, which he alleges to be a common consequence of his occupation. In his case the palsy is not very severe, though quite bad enough to prevent him from raising a glass steadily to his lips; looks stout and well; intellect perfect; has had the metal-ague scores of times. When he was working as a caster he did not dare to get into a cold bed, as the doing so invariably brought on shivering. In general felt some premonitory symptoms the day before an attack, which prepared him to expect its accession. These consisted of dyspnœa, tightness of chest, and general malaise, which were followed at night by shivering, succeeded by sweating. With the exception of the inconvenience arising from their unsteadiness, he has the free use of his hands, but, unless supported, they are constantly agitated. The son of Mr. Parkes, who works in the same factory with

his father, has also a slight shaking of the hands, and, according to the foreman, nearly all the casters in this employ are more or less tremulous.

And now as regards the cause of this curious malady. The men themselves attribute it to inhaling the fumes of deflagrating zinc, or *spelter*, as it is more commonly called in the casting-shops, and there can be no doubt, from the facts about to be adduced, that this opinion is perfectly correct, for, on the one hand, iron-founders, puddlers, furnace-men, and several other operatives, are exposed while at work to conditions exactly similar to those of the brass-founders, except the liability to inhale fumes of zinc, and yet none of these suffer from symptoms analogous to metal-ague; and on the other hand, brass-founders suffer from this peculiar ailment in almost exact proportion to their liability to inhale these fumes. In order to render this perfectly clear, it appears desirable to describe briefly the process of making brass. This is done in crucibles or pots plunged into a sunken furnace, and covered, in order to exclude the air. The copper is first placed in the crucible, and as zinc, the other principal ingredient of brass, deflagrates at the temperature at which copper melts, it is only added shortly before the end of the process, when the copper is perfectly molten. When, after the metals are melted, the crucible is uncovered, for the purpose of stirring them together, and more particularly when it is lifted out of the furnace and the molten brass is being poured into moulds, the zinc deflagrates, and a dense, white smoke is formed, which, almost instantaneously, fills the atmosphere of the casting-shop. This smoke is rapidly converted into snow-like flakes and white powder, consisting of the oxide of zinc, which remains for some time diffused through the atmosphere of the shop, and in ill-ventilated casting-places, collects upon the rafters and ceiling in the form of a dense, white incrustation. The quantity of fumes given off depends mainly upon the proportion of zinc employed in making the brass, which varies with the purpose for which the brass is intended. Moreover, a much greater quantity is given off when the metals

are mixed to make brass than when brass ingots are merely remelted. The proportion of the fumes contained in the atmosphere of the casting-shops likewise varies with their size and ventilation, the fumes being more concentrated and remaining longer in small and ill-ventilated, than in larger and better ventilated, shops. Many of the modern shops are loftier than the older ones, and, besides having unglazed windows, are usually provided with an opening in the roof, in order to favour the rapid escape of the fumes. The rapidity with which these pass away depends also, in a considerable degree upon the weather, their escape being quicker in clear, bright weather than in foggy or heavy weather.

The evidence which at first appeared so contradictory was, on further inquiry, fully explained by the facts that have just been related, viz., that brass-founders are not all equally exposed to the cause of this curious malady, and, viewed under this aspect, that evidence affords conclusive proof that the fumes of deflagrating zinc are really the sole cause of this complaint. A few men who use but little zinc in their castings, or cast but rarely, altogether escape the disease. Others, who only remelt brass bars, suffer comparatively little, and of those who mix the metals they suffer most who employ the largest proportion of zinc in this manufacture. Other things being equal, men who make heavy castings suffer more severely than those who cast smaller articles. It was likewise clearly ascertained that men who work in large, airy, well-ventilated workshops, suffer less than such as work in smaller and ill-ventilated places. Some of the casters cover the mouth and nostrils with a handkerchief while casting, a precaution which tends to prevent them inhaling the fumes, and these men, if they do not altogether escape, at least suffer in a slighter degree than others in the same shop who neglect this practice.

When men have suffered repeatedly from this ailment, as is the case with most old casters, they become so susceptible that a very trifling cause suffices to induce an attack, even though they may not have experienced the symptoms

which, during the latter part of the day, usually usher in the paroxysm. Thus, getting into a cold bed very often produces shivering, followed by sweating, and very slight disturbances of the health are apt to bring on a paroxysm of this complaint. The men themselves have a very strong belief in the prophylactic and curative influence of milk, which many of them habitually drink for this purpose, and they assert that the occasional use of emetics has a tendency to prevent the disease. I may add, in conclusion, that this disease is entirely unknown among operatives, such as makers of galvanized iron, who work over molten zinc when the temperature is not high enough to cause deflagration and oxidation of the metal.

ON THE CONNECTION

BETWEEN A

LOCAL AFFECTION OF THE LYMPHATIC SYSTEM

AND

CHYLOUS URINE;

WITH

REMARKS ON THE PATHOLOGY OF THE DISEASE.

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The view now proposed of the hitherto obscure disease characterised by a chylous condition of the urine was first suggested by several interesting cases which presented themselves at the male dispensary attached to the Jamsetjee Jejeebhoy Hospital, under my charge. They are narrated in the order of occurrence, which order serves also to place them in the mutual relation best illustrating the views now brought forward.

There is, first, an instance of well-marked local derangement of the lymphatic system, accompanied by the accumulation of chyle, and its occasional discharge from the cutaneous surface. The urine is unaffected.

The next is a case in which also a local affection of the

lymphatic vessels and glands is present, and, as well, a frequent external discharge of chyle. But the urine, too, is frequently chylous, in the strict sense of the word.

Lastly, without any external local affection of the lymphatics, the patient presents a striking instance of chylous urine, also intermitting in character.

Case 1.—A Parsee youth, in fair health, attended July 15th, 1859. Suffers from slight fever. The inguinal glands are greatly enlarged, soft and doughy to the touch, but not painful. On the cutaneous surface of the thigh, a few inches below Poupart's ligament, is a small, hardly perceptible pimple, from which there occasionally issues a milky fluid, and sometimes so copiously that in the course of the day a pint has been collected. Pressure just above the spot causes the flow to cease: when the spot itself is compressed the fluid squirts out to some distance, leading to the supposition that there is a small dilated sac behind the orifice. Appetite and diet normal.

History.—Six months since, the discharge spontaneously commenced; it lasted two or three days, and then ceased, pressure having been used: it reappeared after the interval of a month, and again stopped after a few days. The present is the third time the discharge has reappeared. Before it comes on, the glands in the groin become, as he states, tumid, and rather painful: afterwards this ceases.

On August 7th and 31st there was a copious flow of chyle; in the interval it ceased. The axillary glands on the left side inflamed and suppurated. Health improved under the influence of iodide of potassium.

In September, 1860, he was seen again, and was suffering from slight fever; the inguinal glands were enormously enlarged, and the local discharge continued the same. Health unaffected.

Description of the fluid discharged.—When collected in a tumbler, its resemblance to rich milk is striking: its colour is yellowish or bluish white, but it soon acquires a rather pink tint. It possesses a faint, hardly perceptible odour,

and a reaction slightly alkaline. A drachm collected in a test-tube coagulates in about five minutes; it separates a few hours afterwards into clot and serum, the latter being milky in appearance: at a later period the whole becomes again fluid. The clot is tolerably firm. On one occasion the patient brought two tumblers filled with chyle, which he had collected during the night. The flow was constant and abundant while it lasted.

Microscopic examination, two hours after removal.—In the fluid were found a universal hazy tint; groups of minute granules; red blood-corpuscles, some apparently dividing; oil-globules of various sizes; granular corpuscles, from a little above the size of the latter up to $\frac{1}{2000}$ of an inch in diameter, the larger being also nucleated; a few masses of granules.

Further details of the case, and figures illustrating the microscopic appearances, are in my possession, but it will be sufficient to indicate the identity of the fluid discharge with chyle, which the microscope proves.

Case 2.—An adult Hindoo became an out-patient August 23rd, 1859, on account of an affection of the scrotum. The skin of this part is corrugated in a peculiar way, thickened, and studded with numerous small tubercles, which are soft to the touch, and, when punctured, freely discharge a chylous fluid. The size of these tubercles (or varicosities) varies from that of a pin's head to that of a pea, or even larger. The inguinal glands on both sides are much enlarged, soft, and doughy to the touch, and they diminish in size under pressure.

History.—Four months since, the scrotum began to enlarge. Native applications were made, and it was only after a time that the peculiar corrugation of the skin appeared. The milky discharge occasionally occurs spontaneously, and it intermits: at present it has been going on for two days, and he reckons to have lost about one pound of fluid daily. It does not issue from any one spot, but from several; it may be, according to the number and position of the tubercles

that have burst. When it ceases, and sometimes also during the time the discharge is going on, the urine becomes chylous, and frequently coagulates. Such is his own account. Health indifferent; no appetite. He was afterwards admitted into hospital, and I found that the tumefaction of the inguinal glands seemed to alternate with the appearance of chyle in the urine. This circumstance was sufficiently established. The parts also became tumefied a short time (two or three hours) after a full meal, and then again subsided. There did not appear to be any regularity in the appearance or disappearance of chyle in the urine.

When normal, the urine was clear, high-coloured, and unaffected by heat or nitric acid. When chylous, its colour was either white, reddish white, or light pink, with a subsequent deposit of pink particles (blood-corpuscles): in the first case a pinkish colour was usually assumed after some exposure to air. Generally the urine coagulated more or less completely, the clot assuming a red colour. Its quantity was considerably increased, and it very readily underwent decomposition. Specific gravity, 1017.

The fluid that escaped from the scrotum was probably chyle, or a mixture of this with lymph. About two drachms were collected in a test-tube, which was then corked. In about two or three minutes, while flowing, the fluid assumed a very decided rose tint, which somewhat increased on further exposure. It coagulated entirely in eight or ten minutes. After an hour or two, when exposed to air, the clot almost immediately changed its colour to blood-red, the milky serum remaining unchanged. On another occasion I found the fluid to coagulate in four or five minutes, and in an hour begin to separate into clot and serum: eight hours afterwards about one sixth of the whole had separated as a milky serum. The clot was slightly red or pink, the uppermost layer, next the air, quite blood-red in colour. During the night the clot dissolved, and all the red particles subsided to the bottom. The change of colour of this man's urine on exposure to air was striking, but far more marked in the chylous fluid: it was almost wonderful to see the bright

pink colour steal over the surface of the clotted mass, the surface of which in a few minutes resembled blood.

Microscopic examination.—The urine was found to contain, besides blood-corpuscles, &c., granular cells much larger than these, and showing, on the addition of acetic acid, three or four nuclei in their interior; they were, in short, chyle-corpuscles. In the chyle the clot was examined two or three hours after removal, and there were found the molecular base; a few small granules; red blood-corpuscles, some well-formed, some granular and starred; corpuscles rather larger than these, with colour less decided and margins slightly irregular (they were almost as numerous as the more perfectly formed (?) or darker red corpuscles); others having a mulberry aspect, varying in size and sometimes flattened; lastly, granular corpuscles, $\frac{1}{2700}$ of an inch in diameter, and resembling the lymph-corpuscles of blood. I endeavoured to watch the change of colour under the microscope, but could not detect any cause for it; red corpuscles were however seen, apparently in various stages of formation. The blood-serum was quite clear.

Various plans of treatment, local and general, the latter including very large doses of gallic acid, were adopted, without producing a favourable effect.

Case 3.—A Hindoo youth came to the dispensary, October 21st, 1860. He stated that his urine appeared to be mixed with milk and blood; that this appearance had come on suddenly two years since. On his rising one morning to make water, a large quantity of milky fluid flowed, and so alarmed him that he nearly fainted. The discharge continued for three and a half months, suddenly ceased for five months, then came on again, lasting nine months; again stopped for two months, and once more recommenced in April last. The urine he brings this morning is of a milk-white colour, with pink and dark-red clots in it. It is said to be copious in quantity, and frequently passed: the clots in it frequently occasion difficulty of micturition. The urine often coagulates, and readily decomposes. No local symp-

toms externally. He is a pallid lad, and complains of rheumatic pains and diminished appetite.

In later visits I gathered that the morning urine was white in colour, while that passed in the after part of the day was reddish, or soon became so. On November 16th he passed in my presence a large quantity of urine, the colour of which was at the outset brick-red, but towards the close of micturition became lighter and more pink: also a red clot of some size and irregular lobulated form; the colour of this, at first purple, became bright scarlet.

In the intervals when the urine appears to be unaffected he states that it is high coloured, but clear, and less in quantity. Ingestion of flesh or wheaten bread increases the disease.

Microscopic examination of the urine showed the presence of the elements of chyle, chyle-corpuscles of varying size and form, and some red corpuscles of usual size. I have figured and measured some of these objects.

A portion of urine, pinkish, with clots, was put aside in a cool place, and after a while the red corpuscles were found precipitated: the body of the fluid was opaque and nearly white, and on the surface was a thin layer of firm, white substance, which had the appearance of solid, fatty matter.

Instances of the more ordinary forms of chylous urine are not uncommon here. I have by me the notes of two other cases, one of which greatly resembles that last described, and in it the dependence of the opacity and red clots upon the food is yet more striking. If the man, an adult Parsee, abstains from food for an entire day, the urine becomes clear at once. When chylous, it coagulates, is excessive in quantity, but is not influenced by exercise. The other case referred to is that of a young Hindoo, who has long been the subject of chylous urine. The colour is white, and it contains clots. I possess also the notes of an affection of the scrotum similar to that described in Case 2, only at a much earlier stage, and not accompanied by chylous urine. I found in the fluid discharged from the tubercles the elements

of a diluted chyle: heated, the fatty matter rose to the surface, and was readily soluble in ether. There is, published in the 'Edinburgh Medical Journal,' January, 1860, a case altogether resembling, as regards the scrotal affection, that narrated above. The writer, an intelligent medical missionary, does not seem to have recognised the milky fluid as chyle, not having, it would seem, carefully examined it. An operation was performed in this instance, without success. A second case is referred to in the same article. In July, 1854, a graduate of the Grant Medical College recorded a case of partial hypertrophy of the scrotum, attended with a peculiar eruption and discharge.[1] I forbear at present from remarking further on this peculiar affection of the lymphatics of the scrotum and its probable connection with elephantiasis of the same part, in order to avoid confusion.

The cases now reported give evidence of a state of the lymphatic system not hitherto recognised. In the first instance the glands are greatly enlarged and their function increased, the vessels connected with them are also dilated, and there is clear proof that this state extends inwards; as high, indeed, as the thoracic duct, since the fluid discharged at the skin of the thigh is not mere lymph, such as ordinary lymphatic vessels carry, but a rich chylous fluid. Of such a fluid the only source can be the terminal lacteals above, the flow or current being reversed on account of the altered state of the vessels, whose valves are probably useless. Had the chylous fluid, which in this case poured out on the cutaneous surface, been turned upon the urinary mucous tract, we should have had all the phenomena of chylous urine.

In the second case this must, in reality, have occurred. There is a very similar but more marked morbid condition of glands and vessels, and a similar reversal of the flow of chyle; but, in addition, the urine is found to contain chyle, its appearance in that fluid being clearly connected with exacerbation of the local disease.

[1] See the 'Bombay Medical and Physical Transactions' for that year.

Lastly, in the third case the urine has the characters of that last mentioned, but there is no external local disease. It would be difficult, however, to disprove the possibility of more deeply seated local hypertrophy and dilatation of the lymphatic system; the warrantable presumption is that such really existed.

Hitherto anatomical proof of the accuracy of these views has not been obtained, but many of the phenomena of disease are considered to be satisfactorily explained on grounds not so well founded in reason and fact as those now offered in support of the proposed explanation of chylous-urine disease. The following remarks will, it is submitted, substantiate what is now said.

On the Pathology of the Disease.

The *physical properties* of the urine now referred to are well known to most observers. Dr. Prout[1] mentions the white appearance and spontaneous coagulation as characterising this condition, but the latter feature is by no means invariable, and the colour may be tinted red.

As to the *microscopical characters* of chylous urine, there is no great uniformity amongst observers; but the points of uncertainty have mostly turned upon the presence or absence of oil-granules and oil-globules. No writer has hitherto recognised the occurrence of chyle-corpuscles in the urine, though Rayer, and more recently Beale, have mentioned the occasional occurrence of small granular cells (Kölliker's nuclei?).

With respect to the *chemical composition* of chylous urine, the presence of albumen, more or less perfected, and of fat, is universally recognised, as well as the occasional appearance of fibrine. The salts and extractives have not been

[1] In this he has been followed by Watson and others. He first accurately described the disease, and gave the name "chylous," afterwards changing the term to "chylo-serous," apparently in accordance with his altered opinions of its nature.

sufficiently discriminated to allow of satisfactory inference. The only complete analyses of chylous urine accessible to me are those given in 'Beale's Archives,' vol. i, p. 10, two being made by the editor himself, and two others taken from Dr. B. Jones. The qualitative analysis found in the 'Madras Medical Reports' for 1855 furnishes no data for calculation.

Prevailing views of the nature of the disease.—On most occasions, when this part of the subject is treated of, the views of Dr. Prout are brought forward, and adopted wholly or in part. He says, "the chyle, from some derangement in the processes of assimilation, is not raised to the blood standard, and consequently, being unfit for the future purposes of the economy, is, agreeably to a law of the economy, ejected through the kidneys. But these organs, instead of disorganizing or reducing it to the crystallised state, as usual (that is, instead of changing the chyle into the lithate of ammonia), permit it to pass through them unchanged."[1] Dr. Prout was well aware that the adoption of his views necessitated two suppositions, viz., mal-assimilation and coexisting renal derangement, but neither of these is tenable in the face of facts to be presently mentioned. We might also ask, what is the nature of a derangement in an organ which persists for years: can such a derangement be "purely functional"? Dr. Elliotson would regard the affection as renal,[2] but contents himself with saying the kidneys have been found diseased. Drs. G. Bird and B. Jones also incline to a similar view, but no evidence of renal disease is forthcoming; indeed, it may be wanting, as Beale (l. c.) infers. This author, probably the last who has written on the subject, supposes that the chylous condition of the urine is intimately connected with the absorption of chyle, but how it is so does not appear from his remarks. The view now advanced is that it is rather con-

[1] 'On Stomach and Renal Diseases,' 5th ed., p. 116.

[2] 'Med. Times and Gaz.,' 1857, p. 288.

nected with an *abnormal distribution of the chyle, which becomes admixed with the urine in a direct manner*, and not through abnormal excretion of the chyle, as Prout supposed, or its absorption, as Beale thinks.

We can hardly admit that, as a general feature of the disease, a part of the abnormal constituents, as albumen, fibrine, and corpuscles, is derived from the blood, and the fatty matters from the food. The proposed explanation given further on (*i. e.*, the substitution of lymph for chyle) is equal to account for such varieties.

Circumstances not explicable on the generally received hypotheses.

1. The frequent sudden appearance, and almost capricious cessation and recurrence, of the symptoms.

2. The absence of a chylous condition of the blood, the absence of uniform or determined kidney disease, and the absence of such constitutional disturbance as would necessarily accompany prolonged derangement of the assimilative processes and renal functions.

3. The very long duration of these symptoms.

To these we may add the well-marked endemic nature of the affection, and its frequent complication with hæmaturia.

Circumstances satisfactorily accounted for on the supposition of a direct admixture of chyle, of various degrees of maturation, with the urine.

1. The above-named peculiarity in the origin and course of the disease.—We may suppose that distension of the delicate lymphatics and lacteals in the lumbar region is at length followed by exudation of their contents at one or more points; or, rupture taking place, a fistulous orifice remains, which gives free exit to the chyle or lymph at times of recurring distension; or an abnormal reservoir ("receptaculum") may be formed, which periodically discharges its contents into the pelvis of the kidney, ureter, or

bladder.[1] The cases before related evince that such a condition of the lymphatic vessels, accompanied with enlargement and increased function of the corresponding glands, does occur; that the flow of chyle may be reversed or regurgitation may occur; and that, with this state, the urine may be chylous. It is possible that the large quantity of chyle often mixed with the urine may be partly derived from the hypertrophied glands.

2. The absence of organic change in the blood or kidney is satisfactorily explained; since, on this hypothesis, their implication is no necessary accompaniment of the symptoms. Also, the absence of marked constitutional derangement beyond what is occasionally witnessed—a debilitated state, dependent on the altered destination of nutritive materials.

This remark applies also to the prolonged duration of such cases.

The frequent complication with hæmaturia (see 'Rayer,' l. c.), is explicable on the assumption of a weakened condition of the walls of the *blood-vessels*, such as would probably accompany a similar condition of the *absorbents*, both being indicative of structural idiosyncrasy.[2]

But the following features of chylous-urine disease are still better explained, viz., first, the connection of the symptoms with the digestion of food and stimulus of exertion; and next, the variations observed in the character of the urine in different cases.

It is clear that the rapid formation of chyle in the first case, or its quicker circulation, resulting from exertion or

[1] Cruveilhier observes, "The network of lymphatics on the mucous membranes, including the bladder, urethra, &c., is so superficial that the mercury appears uncovered." ('Descriptive Anatomy,' vol. ii, p. 813.) The lymphatics of the ureter are very numerous.

[2] The endemic prevalence of the disease in Mauritius, Bourbon, Brazil, West Indies, Cuba, and, perhaps, we may add, its greater frequency in India or the East, is sufficiently explained on the supposition of this structural idiosyncrasy. I have often been struck with the delicate texture of the walls of vessels seen in the bodies of natives of India.

whatever stimulates the general circulation of fluids in the body, will be accompanied by an increase of the local changes; by an increased distension of the varicose lymphatics, or overflow of any part dilated into a kind of receptacle, and the consequent passage of chyle into the urinary passages. The case of fluxes generally is the same—hæmoptysis, hæmatemesis, menorrhagia, &c.

With regard to the different states of the urine in this affection, it will readily be admitted that, if the abnormal communication between the lymphatics and the urinary passages occur at various parts in the course of the former, the "chylous" condition will also vary accordingly.

I have made a table showing the state of the chyle at three several points in its course, and have annexed some references to published cases of the disease, which will serve as illustrations of the state of the chyle at the time of admixture on each occasion. The principal results are that, when chyle of dense opacity and free from fibrine, causing the urine to resemble milk, is poured out, it is presumable that the admixture takes place at the upper or lower end of the mesentery, and probably with vessels that have not yet passed through the series of mesenteric glands. I am of opinion, however, that fibrine does often really exist in such cases, but is not apparent to the eye (nor could it be chemically detected) from being small in quantity or imperfectly matured. It is also not likely that the lacteals in the early part of their course could communicate directly with the urinary passage.

On the other hand, when the urine rapidly solidifies, and takes on a reddish tinge on exposure to air, or contains white or red clots at the time of expulsion, we may suppose the communication is placed higher up, or with the larger lacteals or thoracic duct itself, possibly opening on the mucous surface of the pelvis of the kidney or commencement of the ureter.

Again, when the urine contains only albumen and fibrine, and little or no fatty matters, as seems occasionally to occur, we are warranted in supposing that at this time (the lacteals

carrying lymph, and not chyle) it is *lymph* which has become mixed with it. The observations of Dr. B. Jones confirm this view, as in his case the opaque, fatty condition only was connected with food, the appearance of albumen and fibrine being rather regulated by exertion. The varying condition of the urine in any single case is explicable on the assumption that chyle (itself differing in quality) and lymph, mixed at such times in different proportions, are poured out.

Lastly, two other occasional features of chylous urine, viz., the large quantity of fluid often passed, and its tendency to decomposition, are readily understood in the view now taken. The latter circumstance may be partly owing to the immature state of the albuminous compounds of the chyle.

If, in the above observations, other occasional states have been overlooked, it need not be supposed they contradict what has been said; too little is known of the normal composition and variations of chyle to permit refinement in comparisons.

The idea of mixing chyle and urine long since occurred to Rayer, and the mixture had a striking likeness to chylous urine.[1]

Proofs of the accuracy of these views.—In confirmation of previous remarks, under this head, it is proposed to consider certain facts which amount to proofs of a strongly presumptive kind. These may be arranged as—1. Chemical. 2. Microscopic.

1. *Chemical evidence.*—The two chief abnormal ingredients of chylous urine are albumen and fatty matters. With regard to fibrine, it is occasionally absent, and frequently small in amount; in chyle itself the quantity of

[1] "En examinant cette urine chyleuse comparativement avec une mélange d'urine saine et du chyle rosé recueilli dans le reservoir de Pecquet, chez un cheval, l'analogie de ces deux liquides, de l'urine chylense artificielle et de l'urine chyleuse de l'homme, m'appara des plus frappantes. . . . . Quant aux urines albumino-graisseuses elles ressemblaient une urine dans laquelle on aurait ajouté les élémens organiques du chyle, moins ses globules." ('Mal. des Reins,' t. iii, p. 421.)

fibrine varies. The salts and extractives of chyle have not yet been sufficiently discriminated to allow of comparison with similar constituents of the urine. Confining, therefore, our observations to the two first-mentioned ingredients, it will at once be obvious that, when present in the urine, they should, in accordance with the hypothesis now advanced, be found in relative proportions similar to those of chyle, since neither is present normally in the renal secretion. It is equally apparent that the quantity of chyle mixed with the urine may greatly vary.

Now, on comparing the analysis of chylous urine and chyle itself, we find that in the former albumen and fat exist in the same proportion as in the latter.

For example, Rees' analysis of *chyle* gives the following figures:

	Per 1000.	
Fibrinous matters	3·70	
Albuminous matters	35·16	proportions
Fatty matters	36·01	nearly equal.

The chyle of the cat was found by Nasse to contain—

	Per 1000.	
Fibrine	1·3	
Albumen[1]	33·25	proportions
Fat	32·7	nearly equal.

So that in well-elaborated chyle these ingredients are found in about equal proportions; in urine mixed with chyle the relative quantities should be the same.

Such is sometimes the case. Dr. L. Beale[2] analysed a specimen of chylous urine, and found—

	Per 1000.	
Albumen	13·0	proportions
Fatty matters	13·9	nearly equal.

[1] The numbers are, albumen *and extractives*, 48·9 per 1000. In order to obtain the quantity of albumen alone, I have deducted the extractives, taking the numbers Rees gives for them, viz. 15·65; there then remains the amount indicated above.

[2] Loc. cit., p. 12.

These numbers appear to me to correspond far too closely to be the result of mere accident; and, admitting this, the inference I have made is natural and logical. The actual quantity of albumen and fat in Beale's case indicates a dilution of chyle with urine to the extent of upwards of two thirds.

In similar circumstances the composition of chyle must always be the same, but both differ at times: so does the composition of chylous urine. I give another example. Nasse analysed the *chyle* of the horse, and found only half the quantity of fatty matters, as compared with albumen.

	Per 1000.	
Fibrine . . .	·75	
Albumen . . .	31·00	proportion, 2 of albumen
Fat . . .	15·00	and 1 of fat.

Dr. B. Jones furnished two analyses of *chylous urine*, the only others I know of, and has recorded this result:

	1. Per 1000.	2. Per 1000.	
Albumen . .	14·03	13·95	proportion of albumen,
Fat . . .	8·37	7·46	nearly double.

In this instance, as in the first, the correspondence is striking enough to warrant close attention, and confirms the inference drawn from the first example given. This comparative mode of viewing the subject I conceive to be the most legitimate; and, bearing in mind the normal variations chyle is liable to, I find no contradiction of an insuperable nature in these two cases. If this be granted, the explanation I propose appears to represent the truth. No other fluid than chyle has the same composition, and, so far as I am aware, no ingredients of chylous urine are not found in either this fluid or the urine itself. (See the Table at the end.)

2. *Microscopical evidence.*—It may first be remarked, under this head, that the presence of a "molecular base" in chylous urine has already been established, and the

occasional presence of minute oil-globules, such as occur in chyle.

Granular corpuscles have also been noticed, as before stated, but in no instance have true chyle-corpuscles been recognised. The presence of these would necessarily settle the question of the presence of chyle. In Case No. 3, I have ascertained their undoubted existence in considerable numbers; and they were also found in the urine of Case No. 2. In the former they were of various form and size—minute granules; round granular corpuscles, whose walls were not visible; some elongated, some of larger size, with distinct cell-wall, starred, or furnished with the characteristic processes; others still larger, varying in diameter up to $\frac{1}{3000}$ in., the smaller ranging from $\frac{1}{6000}$ to $\frac{1}{3500}$ in. A few red blood-corpuscles were seen, and cells larger than these, with irregular margins, but clear. In a specimen examined immediately after being passed, I found granular masses of rounded form; pale, clear corpuscles, which appeared to be red blood-cells, altered in shape, elongated, curled up, and variously bent; others were clearer, a little larger, tuberculated, and having incipient processes attached. It was easy to see that all were not red blood-cells, or, indeed, identical with any found in the blood. In Case No. 2 the urine contained, besides red corpuscles, many granular cells much larger than these, and showing, on addition of acetic acid, three or four nuclei. (Quoted from clinical records.)

The microscopical examination of these urines, then, gave positive proof of the admixture of a fluid dissimilar to blood and similar to chyle, as chemical analysis shows. With regard to the negative results of others, it does not contradict, but only falls short of, what I have witnessed. Nor can it be objected that my cases were not fair examples of the disease. No inconsiderable item in the evidences is derived from the determination of a molecular base. Beale, Priestley, and others, have established this. In further examinations of chylous urine it may be advisable to examine any sediment that may form, and take other precautions to ascertain the existence or non-existence of

chyle-corpuscles. Kölliker[1] remarks, "a considerable variation exists, and a milk-white chyle is not always rich in corpuscles."

I might now proceed to show that the microscopic variations of chylous urine are explicable, like the chemical, on the supposition that chyle became mixed with urine at different points in different cases, but shall content myself with summing up the peculiarities of chyle, which, if detected in the abnormal urine, would not only establish the presence of that fluid, but also assist in determining the locality whence it may have been derived. Kölliker[2] finds in chyle immeasurably fine granules (molecular base); nuclei of $\frac{1}{10,000}$ to $\frac{1}{5000}$ in. in diameter; chyle-corpuscles, $\frac{1}{4000}$ to $\frac{1}{1800}$ in., or larger, and red corpuscles. In the larger mesenteric trunks the chyle-corpuscles first appear, and are then imperfectly formed; size, $\frac{1}{5000}$ to $\frac{1}{3200}$ in. Nearer the thoracic duct, they become more numerous and much larger, and some may be seen dividing. In the last-named locality the larger corpuscles disappear, and ordinary chyle-cells are seen. The presence of numerous free nuclei would indicate early admixture of chyle; the very large corpuscles, with several nuclei, &c., a later; and the presence of well-formed chyle-corpuscles only, a derivation of the chyle from the thoracic duct.

With regard to a phenomenon observed in the chyle derived from the thigh and scrotum, in Cases No. 1 and 2, I endeavoured to witness under the microscope the change of colour there observed, but did not succeed. The change is possibly chemical, for Rees has found a considerable quantity of oxide of iron in the albumen of chyle, which latter, in the analysis, would be mixed with the corpuscles.

[1] 'Human Histology,' p. 517.
[2] 'Manual,' p. 514.

Chemical Analysis.

Chyle.			Chylous Urine.		
	Nasse.	Rees.		Beale.	
Water	905·70	902·37	Water	947·40	First example. Albumen and fat in nearly equal proportions.
Fibrine	1·30	3·70	Urea	7·73	
Albumen ...	[1]33·25	35·16	Albumen ...	13·00	
Fatty matters	32·70	36·01	Fatty matters	13·90	
Extractives	15·65	15·65	Ext. and urie	11·66	
Salts	11·40	7·11	Salts	6·31	
				B. Jones.	
	Nasse.			1	2
Water	935·00	Water		955·58	943·13	Second example. Albumen and fat: the albumen being double in quantity.
Fibrine	·75	Urea		13·26	24·06	
Albumen ...	31·00	Albumen ...		14·03	13·95	
Fatty matters	15·00	Fatty matters		8·37	7·46	
Extractives	6·25	Loss		·75	·60	
Salts	8·00	Salts		8·01	10·80	

Cases of Chylous Urine, arranged in physiological series.

First Series.—Chyle from the lacteal vessels.

Characters.—Albumen plentiful; generally no coagulum or fibrine; molecular base abundant; oil-globules of varying size; free nuclei.

Examples.—Rayer, l. c., pp. 395, 403 (in this case the blood was also affected); G. Bird, 'Urin. Dep.', pp. 390, 394; Bramwell's case, 'Ed. Med. Jour.,' 1858, p. 714.

Cases in which fibrine is at all times totally wanting are of doubtful occurrence.

Second Series.—Chyle from the mesentery.

Characters.—Albumen and molecular base diminished; oil-globules fewer. Fibrine appears. Free nuclei few. Imperfect chyle-corpuscles. The colour is white, and coagulation imperfect.

Examples.—Rayer, l. c., p. 388; Elliotson, 'Med. Times and Gaz.,' 1857, p. 288; Beale's case, l. c.; Pearse, 'Mad. Med. Rep.,' 1855; Prout, l. c.; cases narrated in Morehead, 'Clin. Res.,' vol. ii. Own cases.

[1] In the original analysis the extractives are estimated along with the albumen. In order to obtain the quantity of the latter, the extractives have to be subtracted, and, taking the analysis of Rees, which closely corresponds, I subtracted 15·65 from the figures of both constituents combined, viz., from 48·9. Thus, for albumen, we have 33·25.

Third Series.—Chyle from the receptaculum chyli and thoracic duct.

Characters.—Fibrine abundant. Chyle-corpuscles more numerous, more perfect, and of larger size. No free nuclei, or few. Incipient red corpuscles. Coagulation quick and complete, but varying.[1] A decided red tinge on exposure to air. Fat floats on serum.

Examples.—Rayer, l. c., pp. 390, 427; Priestley, 'Med. Times and Gaz.,' 1857, p. 382; Elliotson, l. c., p. 288; B. Jones, 'Phil. Trans.,' 1850, p. 651. Own cases.

Fourth Series.—*Lymph urine.*

Characters.—The urine coagulates; albumen is present; corpuscles few, but *no fatty matter*, or a few granules.

I add this series, believing in its real existence. The urine would have the above characters in the intervals of digestion or after fasting. In this case, also, the fibrine may seem to be absent, and even albumen not to be detected by the usual tests. (Thudichum, l. c., p. 240.)

Examples.—Dr. B. Jones's case, at intervals. Goodeve's case, 'Trans. of Med. and Phys. Soc. Calcutta,' vol. viii:—An aged female: urine, when clear, "occasionally loaded with transparent jelly, which, floating in it, was not easily distinguishable from the fluid itself until the contents of the receiving vessel were poured into another pan, when it became evident that the excretion was almost entirely composed of solid matter." "There was not the slightest tendency to dropsy in this case." The disease had lasted six months, and had all the features of chylous urine excepting the above: the patient was a large eater, particularly of animal food.

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[1] Carpenter, 'Human Physiology,' 5th ed., p. 123, "On Chyle:"—"It is curious, however, that considerable differences in the perfection of the coagulation, and in its duration, should present themselves in different experiments. Sometimes the chyle sets in a jelly-like mass, which, without any separation into coagulum and serum, liquefies again at the end of half an hour, and remains in this state." The admixture of urine may be supposed to further modify this process.

DESCRIPTION OF PLATE III.

Fig. I.—Case 1. Lymph (chyle?) from the thigh, two hours after removal. Contents:

a. Groups of minute granules; a few masses of granules; a hazy tint.

b. Red blood-corpuscles, some apparently dividing; oil-globules (?).

c. Granular corpuscles, $\frac{1}{3500}$ to $\frac{1}{2000}$ in. in diameter, the larger being nucleated.

Fig. II.—Case 2. Varicose lymphatics and hypertrophied lymphatic glands, accompanied with external discharge of chyle and perfectly chylous urine.

Fig. III.—Case 2. Lymph (chyle?) from the scrotum. Contents of the clot.

Molecular base: few granules.

a. Red blood-corpuscles, $\frac{1}{4000}$ to $\frac{1}{6000}$ in. in diameter, some granular and starred.

b. Corpuscles rather larger ($\frac{1}{3800}$ to $\frac{1}{3000}$ in.), but like them; colour less decided, and margins less irregular; numerous.

c. Numerous nuclei, varying in size ($\frac{1}{3500}$ to $\frac{1}{2500}$ in.); some mulberry-shaped, some flattened.

d. White blood-corpuscles (?), very few; $\frac{1}{2700}$ in.; fibrinous striæ.

Fig. IV.—From chylous urine. Chyle-corpuscles, of various forms and sizes, $\frac{1}{2500}$, $\frac{1}{3200}$, and $\frac{1}{3000}$ in. in diameter. A few red corpuscles.

G H Ford

W West, imp.

ON A CASE

OF

CHYLOUS URINE.

BY

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Received Jan. 11th.—Read Feb. 25th, 1862.

Cases of chylous urine so rarely occur in this country, our opportunities of observing them are so few, and our knowledge of the nature and pathology of the disease under which the secretion of the kidneys assumes the peculiar character which has given a name to the affection is so imperfect, that it is very desirable that in any instances which may come under our notice a careful record should be kept of the symptoms which present themselves, as well as of the effects produced by any remedial measures which may be employed. It is also desirable that the details of such cases, alike with regard to the characters of the urine, the nature of the symptoms, and the results of treatment, should be made known as widely as possible, in order that correct principles may be laid down with reference to the pathology and therapeutics of the affection. With these views, I have thought that a record of the following case, which affords a well-marked instance of the disease, and in which a steadily progressive improvement followed the use of the remedial measures which were resorted to, might be interesting to the Fellows of this Society no less than to the profession at large.

Edward Quillan, æt. 23, a seaman, was placed under my care in the Liverpool Northern Hospital, on October 10th,

1861. He had previously been in the hospital for four or five days, having been originally admitted into the surgical wards under my colleague, Mr. Hakes, for retention of urine. It was soon discovered that the cause of the retention was the coagulation of the urine within the bladder; it was also discovered that the urine was of a milky colour and appearance; he was accordingly transferred to the medical wards. The following is the history that was elicited from the patient.

He is a native of Bermuda, where he has always lived, except when he has been at sea. He entered the mercantile marine service when about twelve years of age, and has made voyages to the West Indies, to Europe, and to North America. He has always had good health, and has never taken medicine. His parents, natives of Bermuda, have also been healthy; they were alive four years ago, since which time he has not heard of them, as he has been away from his home.

He is an intelligent man, five feet five inches high, well-made, somewhat spare. He says he was quite well up to a fortnight before admission. He was, at that time, on his way from New York to Liverpool. The first thing that attracted his attention in connection with his present disease was the stoppage of his water. He took some spirits of nitre, and after that he noticed that his urine was of a milky appearance. He says he is quite sure that the urine became white all at once, and that it had not been changing its character for some time previous to the retention alluded to above. When he perceived the urine was milky, he observed that "little white pieces" came away with it. The urine has continued without any change in its appearance up to the present time. He has had retention of urine once since the first occasion, and before that, for which he sought admission into the hospital. He cannot attribute the attack to any cause; he has not been overworked, nor yet much exposed to cold. He thinks he has been getting somewhat thinner lately. He complains of no pain, and, with the exception of a little weakness, he feels well. He

passes a good deal of water, and has to get up frequently in the night to micturate. He has never known any one in his own country or elsewhere to suffer from a similar affection to his own.

By a careful physical examination of the chest and abdomen, no evidence of visceral disease can be discovered; the lungs are resonant on percussion, and the respiration good; the heart sounds are normal, although somewhat feeble. There is no tenderness over the abdomen, nor in the loins, nor any evidence, on percussion, of hepatic or splenic enlargement. The tongue is clean, the bowels regular, and the appetite good.

The following are the characteristics of the urine passed by the patient at the time of his admission into the hospital, and for several subsequent days.

When first passed, it is white, with rather a pink tinge. It resembles new milk in appearance, and somewhat in smell. It is perfectly free from urinous odour. After it has been passed for a short time it coagulates into a tremulous mass, which assumes the shape of the vessel which holds it, and exactly resembles *blancmange*. The coagulum sooner or later disappears entirely or in part, leaving the urine either altogether fluid or partly clotted. After the urine has been standing for some hours, a distinct deposit of florid blood is found at the bottom of the vessel, and the mass of fluid above assumes a perfectly white colour, showing that the pink appearance of the urine, when first passed, is due to the admixture of blood. There is, in addition to the blood-deposit, a deposit of a somewhat slimy character, having all the appearance of a mixture of pus and mucus. After standing some hours, a distinct, thin layer of white fluid, exactly resembling cream, generally forms on the surface of the urine; the layer being thicker in some specimens than in others. The urine remains free from odour for some time, but at the end of three or four days it has a slightly urinous smell.

When first passed, the urine is slightly acid, or neutral, and soon becomes alkaline. Heat causes a precipitate of

very fine particles. Nitric acid also produces a slight precipitate, but heat and nitric acid together cause a copious deposit. When boiled with liquor potassæ and sulphate of copper, there is no reduction of the latter salt to the condition of sub-oxide. If the urine be agitated in a test-tube with equal parts of strong sulphuric ether and left to stand, a thin layer of fatty matter is deposited on the surface of the urine, and below the ether. The urine then becomes quite clear, and if removed by means of a syphon and boiled with nitric acid, a copious deposit takes place.

When examined under the microscope, the urine is found to contain blood-, pus-, and mucus-corpuscles, with a large number of small fat-globules. Many of these last are very minute, whilst others are larger. No casts of the uriniferous tubes, nor any other abnormal matters than those already mentioned, can be found in the deposit from specimens of the urine allowed to stand one, two, or three days. The thin layer of cream-like fluid before alluded to is found to consist entirely of oil-globules.

During the whole period of treatment the urine passed by the patient at each evacuation of the bladder was kept in a separate vessel. The period at which each specimen was passed was noted, and at the end of every twenty-four hours an examination of the specimens was made, and the specific gravity and general appearance of each put down, together with the quantity that had been passed. The examination was made between one and two o'clock p.m. daily, and it embraced the urine passed in the twenty-four hours previous to one o'clock. The examination was conducted in most instances by myself, but in my absence by the junior house-surgeon of the hospital, Mr. Phelps.

The following abstract, referring to the number of times the urine was passed and the changes which took place in its character, will serve to show the manner in which the patient progressed towards recovery during the time he was in the hospital. The dates given include the period between one o'clock of the first day and one o'clock of the second.

October 11th, 12th.—Urine passed nine times. Every specimen was milky, and contained blood. The sp. gr. varied from 1010 to 1020; the quantity was three and a half pints.

12th, 13th.—No examination made. Quantity, three pints.

13th, 14th.—The number of times the urine was passed was not noted. All the specimens were milky, and contained blood; four contained clots. The sp. gr. of the whole was 1012; quantity, three pints sixteen ounces.

14th, 15th.—Urine passed twelve times. All the specimens were milky, and contained blood; two specimens contained clots. The urine passed at 6 a.m. of 15th was less milky than the others; sp. gr. 1010 to 1015; quantity, three pints fourteen ounces.

15th, 16th.—Urine passed thirteen times. All the specimens were milky, and contained blood; there was a clot in the specimen passed at 5·55 a.m. of the 16th; sp. gr. 1011 to 1016; quantity, three pints twelve ounces.

16th, 17th.—Urine passed nine times. All the specimens were milky, and contained blood, and all but two had clots in them. The urine passed at 12·30 of the 17th, about an hour before examination, was all coagulum. The sp. gr. of the whole was 1013; quantity, thirty-six ounces.

17th, 18th.—Urine passed eleven times. All the specimens were milky, and contained blood; six contained clots; sp. gr. 1010 to 1017; quantity, three pints three ounces.

18th, 19th.—Urine passed fourteen times. The specimens were milky, but some of them contained less blood than usual; seven contained clots; two, viz., those passed at 5·30 a.m., and 7·5, a.m. of 19th, were thinner than usual; more whey-like. There was an unusually thick, cream-like deposit on some of the specimens; sp. gr. 1013 to 1016; quantity, three pints six ounces.

19th, 20th.—Urine passed eleven times. The specimens were all milky, but contained less blood than before; ten contained clots; sp. gr. 1010 to 1015; quantity, three pints fifteen ounces.

20th, 21st.—No examination made.

21st, 22nd.—Urine passed eleven times. It was milky, but contained decidedly less blood; one specimen contained a clot; sp. gr. 1006 to 1014; quantity, four pints.

22nd, 23rd.—Urine passed eleven times. All the specimens were milky; three contained clots; some were almost free from blood.

23rd, 24th.—Urine passed thirteen times. All the specimens were milky; one was free from blood, the rest contained very little; one contained a clot, which was by no means firm; sp. gr. 1008 to 1013; quantity, four pints fifteen ounces.

24th, 25th.—Urine passed fifteen times. All the specimens were milky; some were free from blood, all were free from clots; sp. gr. 1007 to 1012; quantity, six pints.

25th, 26th.—Urine passed fourteen times. It was less milky, and contained but little blood and no clots. Some specimens contained a good deal of a somewhat greenish, slimy deposit, apparently a mixture of pus and mucus; sp. gr. 1005 to 1014; quantity, six pints. (Some urine passed at 1 p.m. of 26th was examined at 2·15 p.m.; it was coagulated, but the clot was neither firm nor large.)

26th, 27th.—Urine passed twelve times. Some specimens were free from blood; one was very milky, some were thin, more limpid than usual, and more of an amber colour. Generally, the urine was less milky than heretofore; sp. gr. 1004 to 1016; quantity, four pints ten ounces. (Two specimens examined to-day, viz., those passed at 6·30 p.m. of 26th, and 6·30 a.m. of 27th, contained a large quantity of albumen.)

27th, 28th.—Urine passed eleven times. All the specimens were more or less milky; three only contained blood, two contained clots; sp. gr. 1009 to 1017; quantity, four pints eight ounces.

28th, 29th.—Urine passed twelve times. Two specimens, passed in the middle of the night, were opalescent, the rest were more or less milky; one contained blood in very small quantity. Reaction of the mass of urine acid; sp. gr. 1009 to 1017; quantity, four pints ten ounces. (The pa-

tient was kept in bed all day, except when he got up to take his bath and to pass water.)

29th, 30th.—Urine passed twelve times. Of the twelve specimens, seven were milky; two only contained a small quantity of blood; one was clotted; two specimens were whey-like; three, viz., those passed at 6·20 a.m., 8 a.m., and 10·15 a.m. of the 30th, were opalescent; sp. gr. 1010 to 1017; quantity, three pints fifteen ounces. Reaction acid. (Patient in bed all day, except when he went down stairs to be weighed, got up for his bath, &c.)

30th, 31st.—Urine passed thirteen times. All the specimens were free from blood and clots; that passed at 6 a.m. of 31st was the most like healthy urine of any passed since admission. Reaction acid; sp. gr. 1005 to 1020; quantity, four pints ten ounces. (Patient in bed.)

October 31st to November 1st.—Urine passed nine times. All the specimens were more or less milky, and free from blood and clots; they all contained albumen; sp. gr. 1013 to 1017; quantity, three pints two ounces. (Patient in bed.)

November 1st, 2nd.—Urine passed six times. Free from blood and deposit. Three specimens were milky, two turbid, one was almost natural in appearance; sp. gr. 1015 to 1020; quantity, two pints six ounces. (Patient in bed.)

2nd, 3rd.—Urine passed five times. There was no blood and no deposit. Three specimens were cloudy, two opalescent; sp. gr. 1015 to 1025; quantity, two pints five ounces. (Patient up.)

3rd, 4th.—Urine passed six times. One specimen was milky, four were turbid, one was opalescent; there was neither blood nor clot; sp. gr. 1012 to 1025; quantity, two pints five ounces. (The patient says that for the last three days the urine has not coagulated at all after being passed.)

4th, 5th.—Urine passed five times. Free from blood and clot; sp. gr. 1012 to 1020; quantity, two pints five ounces.

5th, 6th.—Urine passed seven times. One specimen slightly milky, two turbid, four opalescent; sp. gr. 1007 to 1019; quantity, two pints nine ounces.

6th, 7th.—Urine passed six times. Five specimens turbid, one opalescent, but consisted almost entirely of coagulum. It resembled in colour and appearance slightly opaque jelly; it was passed at 8·30 a.m. of the 7th; sp. gr. 1010 to 1022; quantity, two pints ten ounces.

7th, 8th.—No examination made.

8th, 9th.—Urine passed six times. One specimen slightly milky, four turbid, one opalescent; sp. gr. 1016 to 1023; quantity, two pints eight ounces.

9th, 10th.—Urine passed four times. One specimen was quite milky, and one clearer than any passed since admission; sp. gr. 1018 to 1025; quantity, one pint six ounces.

10th, 11th.—Urine passed six times. Three specimens were very clear; sp. gr. 1012 to 1023; quantity, two pints.

11th, 12th.—Urine passed five times, as follows:—11th, 6·30 p.m., clear, natural; sp. gr. 1015: 8·30 p.m., turbid; sp. gr. 1030.—12th, 3 a.m., slightly turbid; sp. gr. 1020: 8 a.m., slightly turbid; sp. gr. 1018: 12·20 p.m., nearly natural, slightly opalescent; sp. gr. 1010; quantity, two pints. The urine passed at 6·30 p.m. of the 11th contained no albumen; that passed at 8·30 p.m. of the 11th contained a large quantity of albumen; that passed at 12·20 p.m. of the 12th contained a small quantity of albumen. (This was the first day on which the patient passed urine of a perfectly healthy character.)

12th, 13th.—Urine passed five times, viz.—12th, 4·30 p.m., slightly opalescent; sp. gr. 1015: 13th, 1·40 a.m., perfectly clear; sp. gr. 1015: 5·50 a.m., perfectly clear; sp. gr. 1019: 8 a.m., perfectly clear; sp. gr. 1015: 12 noon, perfectly clear; sp. gr. 1025. All the specimens were *free* from albumen; quantity, one pint eight ounces.

13th, 14th.—Urine passed six times. Natural in appearance, and free from albumen; sp. gr. 1015 to 1025; quantity, two pints eight ounces.

14th, 15th.—Urine passed six times. Clear, free from albumen; sp. gr. 1011 to 1023; quantity, two pints sixteen ounces.

15th, 16th.—Urine passed six times. Natural; sp. gr. 1017 to 1024.

16th, 17th.—Urine passed six times. Natural; sp. gr. 1017 to 1026.

17th, 18th.—Urine passed six times. Natural; sp. gr. 1022.

18th, 19th.—Urine passed six times. Natural; sp. gr. 1020.

19th, 20th.—Urine passed six times; sp. gr. 1021. There was a deposit of lithic acid in one specimen.

20th, 21st.—Urine passed six times. Natural; lithic acid in one specimen.

From this time up to the date of the patient's discharge the examination of the urine was not conducted regularly, as before; the general appearance of the urine was, however, noted daily, and the secretion was tested almost every day for albumen. On all occasions the urine was clear, natural in appearance, and free from albumen. On several occasions there was a deposit of lithic-acid crystals, but these disappeared as soon as the gallic acid which the patient was taking was omitted. The patient left the hospital on December 17th, 1861, the urine having been perfectly healthy for the period of five weeks.

The following is an analysis of the urine, as furnished me by Dr. Baker Edwards, of this town. The analysis was made soon after the patient's admission into the hospital, and before any change had taken place in the general characters of the urine.

Sp. gr. 1012.		
Water		967·3
Solid matter, viz.—		
Fat	9·9	
Urea	6·0	
Albumen, with traces of uric acid .	6 0	
Vesical mucus . . .	4·5	
Animal extractive, with a trace of ammoniacal salts . . .	4·1	
Fixed alkaline salts . . .	2·0	
Earthy salts	·2	
	——	32·7
		1000·

The following is an analysis of healthy urine of sp. gr. 1012, as given by Simon:

Water			956·00
Solid matter			44·00
viz.—			
	Urea	14·57	
	Uric acid	0·71	
	Extractive matters and animal salts	12·94	
Fixed salts, 13·77: Alkaline salts.	Chloride of sodium	7·28	
	Sulphate of potash	3·50	
	Phosphate of soda	2·33	
Fixed salts, 13·77: Earthy salts.	Phosphate of lime and magnesia	0·66	
	Silica	a trace.	

It will be seen, by a comparison of the two analyses, that in the chylous urine the following substances were largely present, viz., water, fat, albumen, mucus; and that the following constituents of the urine were deficient in quantity, viz., urea, extractive matters, the alkaline and earthy salts.

Treatment.—The following statement will serve to show the medicinal and other therapeutic means which were employed in the treatment of the case.

October 10th.—Warm bath.

12th.—Quinæ Disulph. gr. jss, Acid. S. dil. ♏x, Inf. Quassiæ ℥j, ter die.

13th.—Port wine, 6 ounces daily.

15th.—Wine omitted.

16th.—Quinæ Disulph. gr. ij, Ferri Sulph. gr. ij, Acid. Sulph. dil. ♏x, Inf. Quassiæ ℥j, ter in die.

17th.—A grain of opium, at bedtime, every night. 6 ounces sherry wine daily.

18th.—Iron and quinine omitted. Gallic acid 10 grs., three times a day.

19th.—Gallic acid increased to 30 grs. daily.

22nd. ,, ,, 45 ,,

24th. ,, ,, 60 ,,

26th. ,, ,, 75 ,, A vapour bath every night.

29th.—Gallic acid increased to 90 grs. daily.
31st.—Wine and opium omitted.
November 1st.—Gallic acid increased to 120 grs. daily.
9th. „ „ 135 „
14th.—Vapour bath omitted.
16th.—Gallic acid diminished to 120 grs. daily.
18th. „ „ 90 „
19th. „ „ 75 „
20th. „ „ 60 „
21st. „ „ 45 „
22nd. „ „ 30 „
25th. „ „ 20 „
28th. „ omitted.

He took no medicine from this date up to the time of his discharge.

The total quantity of gallic acid taken from the 18th of October to the 28th of November was 7 ounces 48 grains.

Diet.—Liberal diet was allowed during the whole of the time the patient was in the hospital, and, as will be seen from the subjoined account, he gained flesh rapidly from the moment the disease began to yield to treatment. The diet consisted of meat and potatoes, eggs, bread, arrow-root, milk, tea, and butter. From the 18th of October to the 2nd of November he took two eggs daily with his breakfast, and from November 2nd to the 30th four eggs daily with that meal. He was allowed no malt liquor, but wine was given from October 13th to the 31st. It was then stopped, and he drank nothing but toast-water in addition to his milk, tea, &c.

WEIGHT.

Date.		st.	lbs.
Oct. 20th.[1]—5 p.m.		8	6
22nd.	„	8	7
24th.	„	8	$10\frac{3}{4}$
26th.	„	8	13
29th.	„	9	5
Nov. 1st.	„	9	$7\frac{1}{4}$

[1] Ten days after admission into the hospital, but five days after he came under medical treatment.

Date.		st.	lbs.
Nov. 5th.—5 p.m.		9	7
10th.	„	9	9¼
14th.	„	9	10
17th.	„	10	0
23rd.	„	10	1
26th.	„	10	4
Dec. 3rd.	„	10	5
7th.	„	10	5
11th.[1]	„	10	6

During the time the patient was under treatment, he was allowed to get up and go about his ward, with the exception of the period between midday of the 28th of October and midday of the 2nd of November, when he kept his bed. During the latter part of his residence in the hospital, after the urine had become quite healthy, he was allowed to go out and walk about the town almost daily. His appetite was throughout good, he complained of no pain nor any other uneasiness from the medicine he took, his bowels acted regularly, and he required no aperients. He was very thirsty as long as the disease lasted, and used to drink largely of toast-water. He was not limited in the quantity of fluid he took, but was advised to drink moderately.

The following observations were made with reference to the general characters of the urine at different periods of the day. It was most milky soon after food, and thinnest and most whey-like early in the morning before breakfast.

The longest periods after the urine had been passed at which fibrinous clots were found in it undissolved were on the following days, viz.—

October 13th.—There was a clot 17 hours after the urine had been passed.

16th.	„	16½	„
18th.	„	19	„
19th.	„	24	„
25th.	„	19	„
22nd.	„	19	„

[1] A week before his discharge.

Pathology. What is the pathological condition of the kidneys, or of the system at large, under which this disease occurs? Our knowledge on this point is very imperfect; that there is no organic affection of the kidneys seems to be proved by the case recorded by Dr. Prout of a patient who died of some other disease whilst suffering from chylous urine, and in whom the kidneys were found, to all appearance, perfectly healthy.

Two views have been more specially entertained of the proximate cause of the disease. The first, that the cause lies partly in the assimilating organs and partly in the kidneys; the second, that the disease is the result of congestion of the kidneys. The first of these views was entertained by Dr. Prout, the second has been advanced by Dr. Bence Jones. I must refer my hearers to the works of the physicians I have quoted for a detail of their opinions, as any lengthened consideration of the arguments which have been adduced in favour of one or the other theory would here be out of place. I may remark, however, that, as far as I have been able to form an opinion of the nature of the disease from the observation of the single case I have recorded, I have been led to entertain the view which I refer to below. I was at one time disposed to consider, not only that there was an abnormal condition of the kidneys in the affection, but also that there was some fault in the assimilative processes of the body; but seeing the manner in which the disease was influenced by the therapeutic means, more especially the powerful astringent, employed, I have come to the conclusion that the affection is one in which the main pathological feature is *a relaxed condition of the capillaries of the kidneys;* that, as a consequence of this condition, the albumen, the fibrine, the fat and the blood-corpuscles are filtered from the blood-vessels, and make their appearance in the urine. The results which followed the treatment adopted in the foregoing case appear to me to bear out the conclusions at which I have arrived. The recovery was steadily progressive, and the changes which took place in the urine were of such a cha-

racter as might be fairly anticipated from the action of an astringent on the capillaries of the kidneys. The effects of the treatment were—first, to diminish the quantity of blood-corpuscles, and subsequently to cause them to disappear; secondly, to decrease the amount of fibrine, fat, and albumen; and lastly, to bring about the entire removal of those substances, so as to leave the urine perfectly healthy.

Such are the changes which actually occurred in the progress of the case, and such, I may repeat, are the changes we might expect would follow as the result of the action of a powerful astringent on the relaxed capillary blood-vessels. The absence of constitutional disturbance, except that of general weakness, and of all those symptoms some of which are so constantly associated with organic disease or even congestion of the kidneys, appears to me to indicate that no structural disease was present, a view which is strengthened by the fact that the urine returned to its natural state, and continued so as long as the patient was under observation. It is true that the patient was not under notice for any lengthened period, and, knowing the tendency which exists for the affection to return, we may fear that the cure in this case may not be permanent. At all events, however, the results show the value of the medicine that was used and its power of controlling the affection, and should encourage us to make a trial of the remedy in all cases that may come under our care. Further, if we wish to derive from the gallic acid its full therapeutic value, we must not be content to administer it in small quantities, but must give it in large and gradually increasing doses. At the same time I believe that, in the case I have reported, the persistent use of the vapour bath had a decidedly beneficial effect, and I should recommend its adoption in all future cases.

APPENDIX.

On the 8th of April, 1862, nearly four months from the date of his discharge, the patient presented himself at the hospital. On leaving the hospital in December he went as a sailor to New York, and at the date given above had just returned with his ship. He had continued in good health, and the urine, he said, had not become milky again. He looked well, complained of nothing, and was quite stout. He passed some urine, which was clear, free from albumen, and had a sp. gr. of 1022.

OBSERVATIONS

ON THE

TACTILE SENSIBILITY OF THE HAND.

BY

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Received Feb. 11th.—Read March 11th, 1862.

The observations which constitute the basis of this paper are submitted to the Royal Medical and Chirurgical Society, in the hope that they will not be regarded as uninteresting or unworthy of acceptance. In prosecuting any inquiry such as this, it is of the highest importance that the first observations should be conducted on a part which is endowed with the greatest amount of tactile sensibility. The phenomena to be noted being subjective, the great difficulty to be surmounted is the acquisition of a standard by which they may be measured. This standard must be entrusted to the memory; it must be definite and decided; and as no part of the body conveys to the intelligence more precise impressions than does the hand, so there is no part with which tactile impressions made elsewhere can be so readily compared.

The succeeding observations are limited to my own person and to my right hand, hence the numbers given apply solely to myself; probably other persons whose hand is of the same size would furnish similar results, but different

numbers would be anticipated with hands of a different size, and hence in female children and large persons. I am disposed rather to agree with Valentin, that the absolute values may differ in different persons, and that a delicate skin and an active mind may modify the absolute results of any experiments, than with Brown-Séquard, who appears to hold the opposite view. In all persons, however, we may expect that the distribution of the tactile sensibility will pretty well coincide.

The method employed in my experiments was that many years ago suggested by Weber, and since commonly employed in medical practice for purposes of diagnosis. I used the ordinary compasses, tipped with cork points; I tried other materials, but fell back upon the cork, as, after all, affording the purest kind of tactile impression; steel points, unless used very lightly, give more or less the impression of a prick, and are decidedly unpleasant, when employed upon thin-skinned parts of the body; cork may be cut with a sharp knife to a very fine point; the only objection to its use is the necessity for an occasional renewal of the points. The pieces of cork should be cut into such a shape that, when the compasses are closed, the adjoining plane surfaces shall lie together without interval, and the points lie at the same level.

The scale adopted for measurement has been the English inch divided into tenths; I used this in preference to the measurement by lines, chiefly because it is that which is, for most other purposes, in use in this country, and is supplied in every case of mathematical instruments.

The plan I adopted to represent the spots of the surface experimented upon was to mark the intended spots with a cross, and having done this I had photographs taken, so as to represent precisely the locality of each observation. For these I am indebted to the kind and ready assistance of my friend, Dr. Matthews. On these photographs I could then mark the results of the observations.

It is well known that the numbers obtainable by Weber's

method differ according to the direction in which the points are placed. When they are placed in the long axis of the part to be examined (I am speaking now of the extremities), the numbers are higher, the measurements greater, than when placed transversely. To represent accurately, therefore, in numbers the sensitiveness of a part, both these measurements must be included; I therefore measured in both directions, and have assumed *their sum to be the absolute sensitiveness of each spot.* On surfaces much curved, if the points included any considerable arc, I have dipped the points in ink, and reapplying them to the surface, have measured with tape between the dots produced, and assumed this measurement as the correct one. In the Appendix the measurements are given both as furnished by the compasses and also by the tape, where this was employed.

The mode in which the experiment is performed is also of some consequence. In experimenting on any spot, the compasses should be opened at first to a distance *less* than what is presumed will be necessary, and should be gradually opened wider and wider until the proper width is attained, that is until the two points are not only unmistakeably felt as distinct impressions, but until the consciousness assures us that there is *a distinct interval between them.* It is easier to discover the lowest measurement which will give this result by proceeding as I advise than by opening the compasses first to a greater width than is necessary and gradually lessening it. The idea of an interval once had at any spot is apt to be retained in the memory, and to vitiate the sensation imparted as the width is reduced. Another precaution I must give, and this arises from a somewhat similar cause. It is to use our experience in guessing the probable width which will be requisite so as to commence at each spot only a little below it. If we commence with too small a width, the touches on the same point will necessarily be more numerous before the proper measurement can be obtained, the attention becomes wearied, and the tactility of the part by repeated touches becomes absolutely lowered. The quicker the measurement can be obtained consistently

with all due care, the more accurate it is therefore likely to be. I will, after these preliminary remarks, proceed to detail the observations I have made. I will merely add that I have since tested their accuracy by repeating them, and that I am not aware of any equally precise or extended observations being in existence. The number of separate spots upon the hand, the tactile sensibility of which has been examined, is 142. On each spot two observations have been made, one in each direction, making thus 284 observations, each of which has been repeated several times for verification. *The mean sensibility of the entire hand,* as thus ascertained, is 1·384 in. *The lowest sensibility* at any spot was found on the dorsum, at a spot corresponding with the base of the fifth metacarpal bone; it is represented by 5·0 inches. *The highest or most acute sensibility* was found at the top of the index finger, viz., ·35 in. The range, therefore, is very extensive.

It is for me now to show how this varying sensibility is distributed.

Hand as a whole.

The sensibility of the surfaces, palmar and dorsal, and of the edges and distal extremity of the hand, have first to be examined.

Palmar surface.—1st. Including the thumb, the fingers lying in apposition, and the thumb laid at the side of the hand. —The number of spots examined on the palmar surface thus constituted (excluding the tips of the thumb and fingers) was 40. The *mean sensibility* may be represented by 1·222 in. The *lowest* sensibility was 2·0 in., and was seated at a spot corresponding to the base of the first and second metacarpal bones. The *most acute* sensibility, ·55, was found at the middle of the last phalanx of the index finger.

2nd.—But the palmar surface may be considered *excluding the thumb.* The number of spots examined thus was 34. The *mean* sensibility was 1·215 in.

Dorsal surface.—1st. The number of spots examined, including the thumb, was 40. The *mean sensibility* may be represented by 1·975 in. The *lowest* sensibility, 5·0 in., was seated opposite the base of the fifth metacarpal bone. The *highest*, ·725 in., was found to correspond with the middle of the last phalanx of both the index and little fingers.

2nd. Excluding the thumb, the number of spots examined was 34. The *mean* sensibility was 2·016 in.

Radial border.—1st. With the thumb in apposition with the border of hand.—The number of spots examined (excluding tip of thumb) was 11. The *mean* sensibility was 1·104 in.

2nd. With the thumb placed in apposition with the palm, and its tip directed towards the middle finger: the border is then formed by the interval between the first and second metacarpal bones and the border of the index finger. The number of spots examined was 10. The *mean* sensibility was 1·447.

Ulnar border.—The number of spots examined was 9. The *mean sensibility* was 1·216 in.

Distal extremity.—This is constituted by the tips of the four fingers. The *mean sensibility* of these is ·4 in.

Comparison of sensibility of the surfaces and borders generally.—1st. Including the thumb.—The order is, distal extremity, radial border, ulnar border, palmar surface, dorsal surface.

The distal extremity exceeds the radial border by $1\frac{3}{4}$ths, or is nearly three times as sensitive.
The radial border exceeds the ulnar border by over $\frac{1}{10}$th.
The ulnar border exceeds the palmar surface by quite a trifle; they may practically be regarded as identical.
The palmar surface exceeds the dorsal surface by over $\frac{3}{5}$ths.

2nd. Excluding the thumb.—The order is, distal extremity, palmar surface, ulnar border, radial border, dorsal surface.

The distal extremity is about three times as sensitive as the palmar surface and ulnar border.
The palmar surface and ulnar border exceed the radial border by under $\frac{1}{5}$th.
The radial border exceeds the dorsal surface by over $\frac{1}{3}$ths.

Comparison of proximal and distal portions of hand.—Weber not only pointed out that the palmar surface of the hand exceeded the dorsal in sensibility, but that the sensibility increased as the distal extremity of the hand was approached. He determined this by the apparent increase in the distance between the points of the compasses when these were fixed, but applied successively to parts nearer and nearer to the extremity of the hand. "In manu autem," he says, "hoc annotandum est, tactum in volari superficie subtiliorem esse quam in dorsali, simul autem eo auctiorem deprehendi, quo propior locus in manu apicibus digitorum est." ('Annotationes Anatom. et Physiol.,' prol. viii.)

An accurate appreciation of this fact may be obtained from the observations I have tabulated, in various ways. 1st. We may compare the metacarpal with the digital portions of the hand generally, and those of the palmar and dorsal surfaces in particular, as well as the metacarpal and digital portions of the borders. 2nd. We may examine anatomically corresponding spots which lie in one line across the hand with those which lie in other lines nearer to the apex, both as they form zones on the surfaces and edges and lines on the palmar and dorsal surfaces in particular. 3rd. We may trace the same law as pertaining to zones at corresponding anatomical parts in the fingers. This last mode I shall defer until I treat of the fingers specially.

1. *Comparison of metacarpal and digital portions of hand generally.*—The anatomical peculiarities of the thumb, which consists of three in place of four bones, and is so situated and arranged as to form, as it were, an opposable hand, render it convenient to exclude this organ from the present comparison, as well as from most of those which succeed. It will be more convenient to consider it separately.

Metacarpal portion of hand, generally, mean of 24 spots, 2·58 in.
Digital „ „ 94 „ 1·045

The digital portion of the hand generally (excluding the thumb) exceeds the metacarpal in sensibility, being, in fact, about one and a half time more sensitive.

Comparison of the metacarpo-palmar and digito-palmar regions (*exclusive of tips of fingers*).—

Metacarpo-palmar region, mean of 10 spots, 1·750 in.
Digito-palmar „ „ 24 „ ·992

The digito-palmar region, then, exceeds the metacarpo-palmar in sensibility by nearly four fifths.

Comparison of the metacarpo-dorsal and digito-dorsal regions.—

Metacarpo-dorsal region, mean of 10 spots, 3·770 in.
Digito-dorsal „ „ 24 „ 1·285

The digito-dorsal region, then, is about three times more sensitive than the metacarpo-dorsal. The greatest difference, then, between the metacarpal and digital regions exists on the dorsal surface of the hand.

Comparison of the metacarpo-palmar and metacarpo-dorsal regions, and of the digito-palmar and digito-dorsal, respectively.—The above numbers enable us to effect this. In the metacarpal portion of the hand the palmar surface is more than twice as sensitive as the dorsal. In the digital portion the palmar exceeds the dorsal in sensibility to much less extent, viz., by about one third. The principal difference, then, between the palmar and dorsal surfaces is found in the metacarpal part of the hand.

Comparison of the metacarpal and digital portions of the radial border of hand.—For the purposes of this comparison we may consider the metacarpal border as formed by the interval between the metacarpal bone of the thumb and that of the index finger.

Metacarpal portion of border, mean of 4 spots, 2·41 in.
Digital „ „ 6 „ ·804

Or the digital portion of the border is three times more sensitive than the metacarpal.

Comparison of the metacarpal and digital portions of the ulnar border of hand.—

Metacarpal portion of border, mean of 3 spots, 1·833 in.
Digital „ „ 6 „ ·908

Or the digital portion of this border is twice as sensitive as the metacarpal.

Comparison of the metacarpal borders and digital borders of hand respectively.—The above numbers enable us to effect this. In the position of the thumb here assumed, the metacarpo-ulnar border exceeds the metacarpo-radial by about one third. The digito-radial border (radial border of index) exceeds in sensibility the digito-ulnar (ulnar border of little finger) by about one eighth.

If we take the other view of the radial border of the hand, as constituted by the radial side of the thumb, and regard parts lying between the same parallels in place of parts corresponding anatomically, we may compare the proximal portions of the two edges thus :

Proximal part of radial border of hand, mean of 5 spots, 1·585 in.
Metacarpal portion of ulnar „ „ 3 „ 1·833

Thus viewed, the radial border will, in this proximal part, exceed the ulnar in sensibility by about one sixth.

Comparison of the metacarpal borders with the metacarpal surfaces (dorsal and palmar).—

Radial metacarpal border (including border of thumb), mean of 5 spots, 1·585 in.
Metacarpo-palmar surface (including that of thumb and its palmar surface to phalangeal joint), mean of 14 spots, 1·596 in.

In this view the radial border of the proximal portion of the hand and the palmar surface of the same are of about equal mean sensibility.

On the other view, where the metacarpo-radial border is

formed by the interval between the first or second metacarpal bones, the metacarpo-palmar surface exceeds it in sensibility by above one third.

Radial metacarpal border (including border of thumb), mean of 5 spots, 1·585 in.
Metacarpo-dorsal surface (including that of thumb to 1st phalangeal joint), mean of 18 spots, 3·080 in.

In this view the radial border of the proximal portion of the hand has almost twice the mean sensibility of the metacarpo-dorsal surface.

In the other view the radial border exceeds the metacarpo-dorsal surface by about three fifths.

The metacarpo-ulnar border is less in mean sensibility than the metacarpo-palmar surface (as partly formed by thumb), the latter exceeding it by about one seventh. The same is the case where the thumb is excluded from calculation, but the difference is very much less, the palmar surface exceeding it by only a small fraction (about one twenty-first).

The metacarpo-ulnar border exceeds the metacarpo-dorsal surface (as partly formed by thumb) by nearly three fourths. The same is the case where the thumb is excluded from calculation, but the difference is greater, the metacarpo-ulnar border being more than twice as sensitive as the metacarpo-dorsal surface.

Comparison of the digital borders with the digital surfaces (palmar and dorsal).—The digito-radial border exceeds in sensibility the digito-palmar surface by nearly one fourth. It exceeds the digito-dorsal surface by three fifths.

The digito-ulnar border exceeds the digito-palmar surface by rather more than one eleventh. It exceeds the digito-dorsal surface by about three sevenths.

II. We may now proceed a step further, and see how the sensibility of the hand, as a whole, increases from the base to the distal extremity. In this inquiry we will exclude

the thumb, which may be made the subject of a separate examination.

Sensibility of zones formed by corresponding anatomical parts on both surfaces and borders of hand from base to distal extremity.

Zone.	Number of spots.	Mean Sensibility.	Excess over previous zone.
1. At base of metacarpus	8	3·175 in.	
2. At middle of metacarpus	8	2·712 „	over $\frac{1}{6}$th.
3. At heads of metacarpus	10	2·115 „	over $\frac{1}{4}$th.
4. At clefts of fingers	10	1·547 „	over $\frac{1}{3}$rd.
5. Between last and 1st phalangeal joints	10	1·325 „	about $\frac{1}{6}$th.
6. At first phalangeal joints	10	1·145 „	under $\frac{1}{6}$th.
7. At middle of 2nd phalanges	10	1·007 „	under $\frac{1}{6}$th.
8. At 2nd phalangeal joints	10	·790 „	over $\frac{1}{4}$th.
9. At middle of last phalanges	10	·680 „	about $\frac{1}{6}$th.
Tips of fingers	4	·4 „	about $\frac{2}{3}$rds.

In even a superficial glance at this table, it will appear that while there is an uninterrupted increase of sensibility in the hand from the base to the tip, there are two remarkable parts at which it increases more rapidly than at others. The necessity of imparting a high sensibility to the fingers leads to a rapid increase as they are approached, and this increase is most observable immediately the heads of the metacarpal bones are passed. The rapid increase of sensibility at this spot was not unnoticed by Weber, although he applied a rough test to it, and applied it only to the palmar surface. It is at the heads of the metacarpal bones that the fingers anatomically commence. We need, therefore, not to be astonished at this rapid increase of sensibility prior to the attainment of the cleft of the fingers. The next part, and that at which the most rapid increase in sensibility of all takes place, is in the distal half of the last phalanges. From the cleft of the fingers to this latter part the rate of increase in sensibility is tolerably regular, being only slightly greater than elsewhere as the second phalangeal joint is approached. Nature here appears to have studied to avoid any great increase on approaching parts of the hand exposed, when the

fist is closed, to collisions, viz., the heads of the metacarpal bones and the first phalangeal joints. We shall see that this is so when we compare transverse lines on the dorsal surface.

Sensibility of transverse lines formed by analogous anatomical parts on the palmar surface.—These lines, as those to be presently considered on the dorsal surface, form part of the zones just considered.

Line.	Number of spots.	Mean sensibility.	Excess over previous line.
1. At base of metacarpus	3	1·900 in.	
2. At middle of metacarpus	3	1·800 „	$\frac{1}{19}$th.
3. At heads of metacarpus	4	1·600 „	$\frac{1}{8}$th.
4. In crease opposite clefts of fingers	4	1·275 „	about $\frac{1}{4}$th.
5. Between last and 1st phalangeal joints	4	1·200 „	$\frac{1}{16}$th.
6. In crease opposite 1st phalangeal joints	4	1·062 „	over $\frac{1}{16}$th.
7. At middle of 2nd phalanges	4	·956 „	$\frac{1}{9}$th.
8. In crease opposite 2nd phalangeal joints	4	·800 „	about $\frac{1}{8}$th.
9. Middle of last phalanges	4	·662 „	about $\frac{1}{7}$th.
Tips of fingers	4	·4 „	about $\frac{2}{3}$rds.

The base of the hand on the palmar surface commences with a comparatively high sensibility, so that in order to attain the maximum at the tip the rate of increase need not be considerable. On this surface it is seen, as with the zones we have just considered, that there is a remarkable increase in the rate of augmentation immediately on passing the heads of the metacarpal bones, followed by as remarkable a decrease. The rate increases again, however, as soon as the parts of the fingers are approached, the palmar surface of which is most employed for palpation, viz., after passing the middle of the second row of phalanges, and especially on approaching the highly sentient tips of the fingers.

Sensibility of transverse lines formed by analogous anatomical parts on the dorsal surface.—The spots examined in these lines correspond to those on the palmar surface, and enter into the formation of the zones above considered.

Line.	Number of spots.	Mean sensibility.	Excess over previous line.
1. At base of metacarpus .	. 3 ...	4·633 in.	
2. At middle of metacarpus .	. 3 ...	3·900 „	under $\frac{1}{3}$th.
3. At heads of metacarpus .	. 4 ...	3·025 „	about $\frac{3}{4}$ths.
4. Opposite clefts of fingers .	. 4 ...	2·012 „	about $\frac{1}{2}$.
5. Between last and 1st phalangeal joints	. 4 ...	1·575 „	over $\frac{1}{4}$th.
6. At first phalangeal joints .	. 4 ...	1·343 „	about $\frac{1}{6}$th.
7. At middle of 2nd phalanges .	. 4 ...	1·181 „	about $\frac{1}{4}$th.
8. At 2nd phalangeal joints .	. 4 ...	·850 „	about $\frac{2}{7}$ths.
9. At middle of last phalanges .	. 4 ...	·750 „	over $\frac{1}{9}$th.

We meet here again with the rapid increase in sensibility after passing the heads of the metacarpal bones, and again on approaching the second phalangeal joints, immediately after passing which, on approaching the nail, the rate of increase drops.

Comparison of corresponding lines on palmar and dorsal surfaces, and of rate of increase of sensibility on these surfaces. —The difference in sensibility of the two surfaces at various distances from the base of the hand may be thus stated:

Line.	
1. At base of metacarpus, palmar surface exceeds dorsal in sensibility by	about $1\frac{1}{2}$ time.
2. At middle of metacarpus, ditto by . .	$1\frac{1}{2}$th. „
3. Opposite heads of metacarpus, ditto by . .	about $\frac{2}{3}$ths. „
4. At clefts of fingers, ditto by . . .	about $\frac{3}{4}$ths. „
5. Between last and 1st phalangeal joints, ditto by .	about $\frac{1}{2}$rd. „
6. At 1st phalangeal joints, ditto by . . .	a little over $\frac{1}{4}$th. „
7. At middle of 2nd phalanges, ditto by .	a little under $\frac{1}{4}$th. „
8. At 2nd phalangeal joints, ditto by . .	$\frac{1}{5}$th. „
9. At middle of last phalanges, ditto by . .	under $\frac{1}{8}$th. „

From this it appears that the difference in sensibility, considerable at the base, where a high sensibility on the dorsum would be inconvenient, gradually lessens as the apex of the hand is approached, where it is important that the dorsum should be little less sensitive than the palmar surface. And in order to attain this similarity, when at the base the sensibility of the palmar and dorsal surfaces is so dissimilar, it is necessary that the rate of increase, band after band, along the dorsum shall be more rapid on the dorsum than on the palmar surface, which originally starts with a more acute sensitiveness. The difference in rate is most remarkable in the proximal bands, and again in the band from the middle of

second phalanges to the second phalangeal joints. In the third band, commencing at the heads of the metacarpal bones, the difference is especially worthy to be observed. On passing the second phalangeal joints the rate of increase is highest on the palmar surface, to provide for the high sensitiveness of the tips.

Comparison of lateral halves of the hand.—We have already seen that the radial border of the hand (as partly formed by the radial side of the thumb) exceeds the ulnar border in sensibility, but that the ulnar border is the more sensitive when the radial border is considered to be constituted by the interval between the first and second metacarpal bones. We shall now see that a similar arrangement prevails if we compare, not the borders only, but the borders and adjoining surfaces together.

Comparison of lateral halves generally, including thumb and palmar and dorsal surfaces of fingers only.—The division is assumed to be formed by a line drawn down between the third and fourth metacarpal bones.

Radial half of the hand, mean sensibility of 59 spots, 1·424.
Ulnar „ „ 43 „ 1·447.

The difference, indeed, is very trifling, but what there is is in favour of the radial side.

Comparison of lateral halves generally, excluding thumb, but including palmar and dorsal surfaces of fingers only.—

Radial half of the hand, mean sensibility of 44 spots, 1·410.
Ulnar „ „ 43 „ 1·447.

Regarded in this way, the difference is again very trifling, but rather greater than when the thumb is included in the calculation.

1. We may now proceed to examine the lateral halves of the palmar and dorsal surface respectively.

Comparison of the lateral halves on the palmar surface, excluding tips of fingers.—

1st. Including thumb.—

Radio-palmar half of hand, mean of 21 spots, 1·139.
Ulno- „ „ 16 „ 1·204.

Thus regarded, the sensibility of the radial half of the palmar surface exceeds that of the ulnar half, but only by a trifle (about one eighteenth).

2nd. Excluding thumb.—

Radio-palmar half of hand, mean of 16 spots, 1·146.
Ulno- „ „ 16 „ 1·204.

Regarded thus, too, the difference is still less, but what there is is in favour of the radial side.

Comparison of the lateral halves on the dorsal surface.—

1st. Including thumb.—

Radio-dorsal half of hand, mean of 25 spots, 1·889.
Ulno- „ „ 16 „ 1·948.

Here, again, the predominance of sensibility is (but still to a very trifling extent) in favour of the radial side.

2nd. Excluding thumb.—

Radio-dorsal half of hand, mean of 16 spots, 1·779.
Ulno- „ „ 16 „ 1·948.

Regarded thus, a similar relation exists, but (otherwise to the palmar surface) the difference is greater than when the thumb is admitted into the calculation; it amounts to somewhat over one eleventh.

The palmar and dorsal surfaces may be compared on the radial and ulnar sides respectively.

Comparison of the radio-palmar and radio-dorsal regions.—1st. Including the thumb.—The radio-palmar exceeds the radio-dorsal surface by something over three fifths.

2nd. Excluding the thumb.—It exceeds it by about four sevenths, rather less than the general average of excess of the whole palmar over the whole dorsal region (two thirds), excluding the thumb.

Comparison of the ulno-palmar and ulno-dorsal regions.—The palmar surface exceeds the dorsal here by close upon the average of the whole surfaces, viz., three fifths.

Comparison of lateral halves in the proximal (metacarpal) region.—

1st. Including the thumb.—

Metacarpo-radial region, mean of 25 spots, 2·037.
Metacarpo-ulnar „ „ 11 „ 2·518.

In the proximal region, then, including the thumb in the calculation, the sensibility being still in favour of the radial half, the excess of that half amounts to nearly one fourth.

2nd. Excluding thumb.—

Metacarpo-radial region, mean of 12 spots, 3·050.
Metacarpo-ulnar „ „ 11 „ 2·518.

Regarded in this way (taking the interval at first and second metacarpal bones as forming part of radial border), the ulnar half of metacarpal region is more sensitive than the radial, the excess amounting to somewhat over one fifth.

Comparison of lateral halves in the digital region.—This only includes the consideration of the digital borders of the hand and the palmar and dorsal surfaces of the fingers.

Digito-radial region, mean of 32 spots, 1·000.
Digito-ulnar „ „ 32 „ 1·079.

There is here, also, a difference in favour of the radial side, which is in excess of the ulnar in sensibility, but only to a trifling extent.

Whether, then, the thumb be included or excluded, the greatest difference between the sides, when the fingers are in apposition, is found in the metacarpal region.

Let us now inquire how the relations of the lateral halves of the hand stand in the proximal and distal parts of the palmar and dorsal surfaces respectively.

Comparison of the lateral halves of the metacarpal region on the palmar surface.—

1st. Including the thumb.—

Radio-metacarpo-palmar region, mean of 8 spots, 1·481.
Ulno- „ „ 4 „ 1·700.

In this comparision it appears that the radial portion of the palm of the hand, when the palmar surface of the thumb as far as the phalangeal joint is taken into the calculation, exceeds the ulnar by above one seventh.

2nd. Excluding thumb.—

Radio-metacarpo-palmar region, mean of 4 spots, 1·750.
Ulno- „ „ 4 „ 1·700.

In this view it appears that the part of the palm to the rear of the index and middle fingers is to a very trifling extent less sensitive than that in the rear of the little and ring fingers.

Comparison of the lateral halves of the metacarpal region on the dorsal surface.—

1st. Including thumb.—

Radio-metacarpo-dorsal region, mean of 12 spots, 2·679.
Ulno- „ „ 4 „ 3·850.

The radio-metacarpal region on the dorsum of the hand then exceeds the ulno-metacarpal region by about one half, the difference between the sides of the hand when the thumb is included being thus very strongly marked, much more marked on the dorsal than on the palmar region.

2nd. Excluding thumb.—

Radio-metacarpo-dorsal region, mean of 4 spots, 3·350.
Ulno- „ „ 4 „ 3·850.

In this view the difference is much less marked, the predominance of the radial side being only somewhat over one seventh.

Comparison of the radio-metacarpo-palmar with the radio-metacarpo-dorsal surface.—1st. Including thumb.—On this

side of the hand, in the metacarpal region, the palmar exceeds the dorsal surface in sensibility by about four fifths.

2nd. Excluding thumb.—Thus considered, the palmar is almost twice as sensitive as the dorsal.

Comparison of the ulno-metacarpo-palmar with the ulno-metacarpo-dorsal surface.—On this side of the hand the metacarpo-palmar surface is about two and a quarter times as sensitive as the dorsal. The difference, then, of the palmar and dorsal surfaces in the proximal part of the hand, is most marked upon the ulnar side.

Comparison of the lateral halves of the palmar surface in the distal (digital) part of hand.—

Radio-digito-palmar surface (index and middle fingers), mean of 12 spots, ·945.
Ulno- „ (ring and little fingers) „ 12 „ 1·039.

The palmar surfaces of the index and middle fingers together thus exceed those of the little and ring fingers together by one tenth. So that, whereas in the metacarpo-palmar region of the hand (exclusive of the thumb), the sensibility preponderates, if at all, to the ulnar side, in the digito-palmar region it preponderates on the radial.

Comparison of the lateral halves of the dorsal surface in the distal (digital) part of the hand.—

Radio-digito-dorsal surface (index and middle fingers), mean of 12 spots, 1·256.
Ulno- „ (ring and little fingers) „ 12 „ 1·314.

On the dorsal surface of the fingers the difference in mean sensibility between the two radial and the two ulnar fingers is less than on the palmar surface.

Comparison of the radio-digito-palmar with the radio-digito-dorsal surface.—The palmar surface of the two radial fingers together exceeds in sensibility that of the dorsal by one third, a very much smaller difference than is found in the surfaces in the radio-metacarpal region.

Comparison of the ulno-digito-palmar with the ulno-digito-dorsal surface.—The palmar surface of the two radial fingers together exceeds in sensibility that of the dorsal by somewhat over one fourth, so that while the difference of the surface in sensitiveness is vastly less than in the metacarpal portion of the hand on the same side, it is also less than exists in the digital region of the radial side.

II. We may now examine more minutely how the lateral halves of the hand differ in sensibility as we proceed from base to apex; we can see, at the same time, the rate of increase of sensibility on the two sides. I again omit the thumb from calculation.

Comparison of lateral halves of zones formed by corresponding anatomical parts on both surfaces and borders of hand, from base to distal extremity.—

Zone.	Radial Side.	Spots.	Mean.	Increase.	Ulnar Side. Spots.	Mean.	Increase.	Difference, excess of. Radial.	Ulnar.
1	Base of metacarpus	3	3·233	—	3	3·000	—	—	About $\frac{1}{12}$th.
2	Middle of ditto	3	2·600	Under $\frac{1}{2}$th.	3	2·566	Over $\frac{1}{20}$th.	—	Trifling.
3	Heads of ditto	5	2·030	About $\frac{2}{7}$ths.	5	2·200	About $\frac{1}{10}$th.	About $\frac{1}{13}$th.	—
4	Clefts of fingers	5	1·500	About $\frac{2}{7}$ths.	5	1·595	About $\frac{2}{9}$ths.	About $\frac{1}{16}$th.	—
5	Between last and 1st phalangeal joints	5	1·290	Under $\frac{1}{2}$th.	5	1·360	Over $\frac{1}{3}$th.	About $\frac{1}{8}$th.	—
6	1st phalangeal joints	5	1·115	Under $\frac{1}{3}$th.	5	1·175	Under $\frac{1}{3}$th.	About $\frac{1}{12}$th.	—
7	Middle of 2nd phalanges	6	·945	Over $\frac{1}{3}$th.	5	1·070	About $\frac{1}{3}$th.	Under $\frac{1}{3}$th.	—
8	2nd phalangeal joints	5	·750	Over $\frac{1}{3}$th.	5	·830	About $\frac{2}{7}$ths.	Under $\frac{1}{3}$th.	—
9	Middle of last phalanges	5	·650	Under $\frac{1}{3}$th.	5	·710	Over $\frac{1}{3}$th.	Under $\frac{1}{10}$th.	—

From this table it appears—1. As respects the difference in sensibility of the two sides of the hand in the several zones, that at the base of the metacarpus the excess is, on the whole, in favour of the ulnar side, but that this difference disappears on proceeding further along the metacarpus, until at the level of the heads of the metacarpal bones the difference is in favour of the radial side, and remains so throughout the remaining distal part of the hand. From this point, however, to the first phalangeal joints the difference becomes gradually less marked, but after this is

considerably increased, lessening again, however, from the second phalanges towards the apex of the hand.

2. As respects the rate of increase of sensibility on the two sides, on proceeding towards the apex of the hand it appears that, on the whole, as the ulnar side commences with a higher sensitiveness than the radial, so that sensibility increases towards the apex at a less rapid rate.

Comparison of lateral halves of transverse lines formed by analogous anatomical parts on the palmar surface.

Line.		Radial Side. Spots.	Mean.	Increase.	Ulnar Side. Spots.	Mean.	Increase.	Difference, excess of. Radial.	Ulnar.
1	Base of metacarpus	1	2·000	—	1	1·800	—	—	$\frac{1}{5}$th.
2	Middle of ditto	1	1·900	$\frac{1}{10}$th.	1	1·700	$\frac{1}{10}$th.	—	Under $\frac{1}{5}$th.
3	Heads of ditto	2	1·550	About $\frac{3}{8}$ths.	2	1·650	Very trifling.	Under $\frac{1}{10}$th.	—
4	Clefts of fingers	2	1·250	Under $\frac{1}{4}$th.	2	1·300	Over $\frac{1}{4}$th.	Very trifling.	—
5	Between last and 1st phalangeal joints	2	1·150	Under $\frac{1}{4}$th.	2	1·250	Very trifling.	Under $\frac{1}{10}$th.	—
6	1st phalangeal joints	2	1·025	Under $\frac{1}{4}$th.	2	1·100	Under $\frac{1}{4}$th.	Under $\frac{1}{10}$th.	—
7	Middle of 2nd phalanges	2	·887	Under $\frac{1}{4}$th.	2	1·025	About $\frac{1}{4}$th.	Under $\frac{1}{10}$th.	—
8	2nd phalangeal joints	2	·737	Over $\frac{1}{4}$th.	2	·862	Under $\frac{1}{4}$th	Over $\frac{1}{10}$th.	—
9	Middle of last phalanges	2	·625	Over $\frac{1}{4}$th.	2	·700	Under $\frac{1}{4}$th.	Under $\frac{1}{10}$th.	—
	Tips of fingers	2	·375	$\frac{3}{8}$rds.	2	·425	About $\frac{1}{2}$rds.	Under $\frac{1}{10}$th.	—

1. Thus, on the whole, the relative distribution of the sensibility on the two sides corresponds with what we found when the lateral halves of the zone were compared, but at most parts the difference between the sides is more marked.

2. The greatest difference in the rate of increase of sensibility, on tracing it from base to apex, is seen in the zone which commences in the middle of the metacarpus and at first phalangeal joints. There is greater uniformity after these joints are passed.

Comparison of lateral halves of transverse lines formed by analogous anatomicol parts on the dorsal surface.

Line.	Radial Side.	Spots.	Mean.	Increase.	Spots.	Ulnar Side. Mean.	Increase.	Difference, excess of. Radial.	Ulnar.
1	Base of metacarpus . .	1	4·100	—	1	5·000	—	About $\frac{2}{5}$ths.	—
2	Middle of ditto . .	1	3·600	Under $\frac{1}{5}$th.	1	4·000	$\frac{1}{5}$th.	About $\frac{1}{5}$th.	—
3	Heads of ditto . .	2	2·850	Over $\frac{1}{4}$th.	2	3·200	$\frac{1}{4}$th.	About $\frac{1}{4}$th.	—
4	Clefts of fingers .	2	1·900	$\frac{1}{3}$.	2	2·125	About $\frac{1}{3}$.	Under $\frac{1}{8}$th.	—
5	Between last and 1st phalangeal joints .	2	1·550	Over $\frac{1}{3}$rd.	2	1·600	Under $\frac{1}{3}$rd.	Very trifling.	—
6	1st phalangeal joints .	2	1·350	Over $\frac{1}{3}$th.	2	1·335	About $\frac{1}{3}$th.	Very trifling.	—
7	Middle of 2nd phalanges .	2	1·137	Under $\frac{1}{3}$th.	2	1·225	About $\frac{1}{11}$th.	About $\frac{1}{19}$th.	—
8	2nd phalangeal joints .	2	·850	About $\frac{1}{4}$rd.	2	·850	Under $\frac{1}{5}$.	None.	
9	Middle of last phalanges .	2	·750	Under $\frac{1}{3}$th.	2	·750	Under $\frac{1}{3}$th.	None.	

1. On this surface it is to be observed, then, that where a difference between the two sides does exist, it is in favour of the radial side, but that after passing the clefts of the fingers there comes to be a very trifling difference observable, and on passing the middle of the second row of phalanges none at all, and this in a part of the digital region where on the palmar surface the difference is the most marked.

2. As regards the rate of increase on the two sides, but little difference is, on the whole, observable.

Comparison of the sensibility of the palmar and dorsal surfaces, on the radial and ulnar halves respectively, in the several transverse lines.

Radial Side.

Line
1. Base of metacarpus . . Palmar surface is twice as sensitive as dorsal.
2. Middle of ditto . . . Palmar surface is nearly twice as sensitive as dorsal.
3. Heads of ditto . . . Ditto.
4. Clefts of fingers . . . Palmar surface exceeds dorsal by over $\frac{1}{3}$.
5. Between last and 1st phalangeal joints . Ditto over $\frac{1}{3}$rd.
6. 1st phalangeal joints . . Ditto under $\frac{1}{3}$rd.
7. Middle of 2nd phalanges . . Ditto over $\frac{1}{4}$th.
8. 2nd phalangeal joints . . Ditto over $\frac{1}{4}$th.
9. Middle of last phalanges . . Ditto $\frac{1}{3}$th.

Ulnar Side.

Line.		
1.	Base of metacarpus . .	Palmar surface is nearly thrice as sensitive as dorsal.
2.	Middle of ditto . .	Palmar surface is more than twice as sensitive as dorsal.
3.	Heads of ditto . .	Palmar surface is nearly twice as sensitive as dorsal.
4.	Clefts of fingers . .	Palmar surface exceeds dorsal by nearly $\frac{2}{3}$rds.
5.	Between last and 1st phalangeal joints .	Ditto over $\frac{1}{4}$th.
6.	1st phalangeal joints .	Ditto over $\frac{1}{5}$th.
7.	Middle of 2nd phalanges .	Ditto under $\frac{1}{5}$th.
8.	2nd phalangeal joints .	Palmar and dorsal surfaces nearly agree.
9.	Middle of last phalanges .	Palmar surface exceeds dorsal by $\frac{1}{14}$th.

Thus it appears that, until the clefts of the fingers are passed, the difference between the dorsal and palmar surfaces is much more marked on the ulnar than on the radial side, but that beyond this line the difference is less marked than on the radial side.

Comparison of the central with the lateral parts of the hand on the palmar and dorsal surfaces.—Generally this comparison may be thus stated (excluding thumb):

	Radial side, mean of	Centre, mean of	Ulnar side, mean of
Palmar surface .	9 spots, 1·177 ...	16 spots, 1·200 ...	9 spots, 1·280
Dorsal ditto .	9 „ 1·888 ...	16 „ 2·037 ...	9 „ 2·105

In this comparison, in the digital region the radial side is assumed to be formed by the surface of the index finger, the central by the middle and ring fingers, and the ulnar by the little finger. Thus compared, it appears that the sensibility on the palmar surface generally may be said to shade off from the radial to the ulnar side, the central part being intermediate in sensibility. On the dorsal surface the same is observed.

Comparison of the central and lateral parts in the metacarpal region on the palmar and dorsal surfaces.—

	Radial side, mean of	Centre, mean of	Ulnar side, mean of
Metacarpo-palmar surface .	3 spots, 1·800 ...	4 spots, 1·725 ...	3 spots, 1·733
Metacarpo-dorsal ditto .	3 „ 3·300 ...	4 „ 4·025 ...	3 „ 3·900

Thus it appears that—1. On the palmar surface (excluding the thumb) the highest sensibility in the metacarpal region is in the centre, and that proceeding from this towards the border the sensibility becomes lowered, but more so towards the radial than towards the ulnar side, which last differs, in fact, very little from the centre in sensibility.

2. On the dorsal aspect the converse is observed; the centre is here the least sensitive part, and the sensibility increases towards the borders, and more markedly towards the radial than towards the ulnar border.

3. As a result of all this, it further follows that the difference in sensibility of the palmar and dorsal surface in this region is greatest in the central part and least in the radial; thus—

The palmar surface exceeds the dorsal in the radial part by $\frac{2}{6}$ths.
" " central " $1\frac{1}{2}$rd.
" " ulnar " $1\frac{1}{4}$th.

Comparison of the central and lateral parts in the digital region on the palmar and dorsal surfaces.—

	Radial side, mean of		Centre, mean of		Ulnar side, mean of	
Digito-palmar surface	6 spots,	·866	12 spots,	1·025	6 spots,	1·054
Digito-dorsal ditto	6 "	1·183	12 "	1·375	6 "	1·208

Hence—1. On the palmar surface the sensibility is highest on the index finger, and shades off towards the ulnar side, becoming least on the little finger. It is worthy of remark that the amount of sensibility of the palmar surfaces of the middle and ring fingers is identical, not only generally, but over each anatomically analogous spot.

2. On the dorsal surface, as in the metacarpal region, the lowest sensibility is found in the centre, the highest (as on the palmar) over the index finger, and the next highest over the little finger. On this surface the two central fingers, however, do not agree so closely in sensibility, the ring finger on the dorsum being less sensitive than the middle finger, although this difference is mainly discoverable posteriorly to the first phalangeal joint.

3. Thus it happens that the palmar sensibility, highest upon the index finger and shading off towards the little finger, becomes intensified on both borders, but chiefly upon the radial; that after turning these borders it again rapidly becomes lowered, until it attains its minimum upon the dorsum of the ring finger.

4. The difference in sensibility between the palmar and dorsal surfaces is greatest on the index finger. The nearest approach to uniformity, however, is found upon the little finger, thus—

The palmar surface exceeds the dorsal on the index finger by over $\frac{1}{3}$rd.
" " central fingers by about $\frac{1}{3}$rd.
" " little finger by about $\frac{1}{4}$th.

Of the two central fingers the palmar surface exceeds the dorsal in the middle finger by less than one third, and on the ring finger by over one third.

Comparison of sensibility of central and lateral parts in transverse lines on the palmar surface.

RADIAL SIDE.

Line.	Spots.	Mean.	Increase.
1. Base of metacarpus	1 ...	2·0	
2. Middle of ditto	1 ...	1·9	$\frac{1}{10}$th.
3. Heads of ditto	1 ...	1·5	$\frac{1}{15}$ths.
4. Clefts of fingers (index)	1 ...	1·2	$\frac{1}{4}$th.
5. Between last and 1st phalangeal joints	1 ...	1·05	$\frac{1}{4}$th.
6. 1st phalangeal joints	1 ...	·95	under $\frac{1}{5}$th.
7. Middle of 2nd phalanges	1 ...	·775	" $\frac{1}{5}$th.
8. 2nd phalangeal joints	1 ..	·675	over $\frac{1}{4}$th.
9. Middle of last phalanges	1 ...	·55	under $\frac{1}{4}$th.
Tips of fingers	1 ...	·35	" $\frac{2}{3}$rds.

CENTRE.

Line.	Spots.	Mean.	Increase.
1. Base of metacarpus	1 ...	1·9	
2. Middle of ditto	1 ...	1·8	$\frac{1}{18}$th.
3. Heads of ditto	2 ...	1 6	$\frac{1}{5}$th.
4. Clefts of fingers (middle and ring)	2 ...	1·3	under $\frac{1}{4}$th.
5. Between last and 1st phalangeal joints	2 ...	1·25	$\frac{1}{12}$th.
6. 1st phalangeal joints	2 ...	1·1	under $\frac{1}{4}$th.
7. Middle of 2nd phalanges	2 ...	1·0	$\frac{1}{10}$th.
8. 2nd phalangeal joints	2 ...	·8	$\frac{1}{4}$th.
9. Middle of last phalanges	2 ...	·7	$\frac{1}{4}$th.
Tips of fingers	2 ...	·425	about $\frac{2}{3}$rds.

ULNAR SIDE.

Line.	Spots.	Mean.	Increase.
1. Base of metacarpus	1	1·8	
2. Middle of ditto	1	1·7	$\frac{1}{17}$th.
3. Heads of ditto	1	1·7	none.
4. Clefts of fingers (little)	1	1·3	under $\frac{1}{3}$rd.
5. Between 1st and last phalangeal joints	1	1·25	$\frac{1}{12}$th.
6. 1st phalangeal joints	1	1·1	under $\frac{1}{4}$th.
7. Middle of 2nd phalanges	1	1·05	very trifling.
8. 2nd phalangeal joints	1	·925	under $\frac{1}{4}$th.
9. Middle of last phalanges	1	·7	under $\frac{1}{3}$rd.
Tips of fingers	1	·4	$\frac{3}{4}$ths.

The middle and ring fingers absolutely agree at each line.

1. At the two proximal lines, then, the sensibility is lowest in the parts corresponding to the index finger, increasing regularly to the ulnar side (the parts corresponding to the little finger), but from the heads of the metacarpal bones onwards towards the apex the predominance is on the radial, and it either gradually lessens towards the little finger or the lowered sensibility of the central finger is maintained unaltered on the little finger.

2. The increase takes place at the greatest rate in the index finger, and the parts where this greater rate is most perceptible are in the band succeeding the clefts of the fingers and that succeeding the first phalangeal joints.

Comparison of sensibility of central and lateral parts in transverse lines on the dorsal surface.

RADIAL SIDE.

Line.	Spots.	Mean.	Increase.
1. Base of metacarpus	1	4·1	
2. Middle of ditto	1	3·6	under $\frac{1}{4}$th.
3. Heads of ditto	1	2·2	about $\frac{2}{3}$rds.
4. Clefts of fingers	1	1·7	under $\frac{1}{2}$rd.
5. Between last and 1st phalangeal joints	1	1·45	over $\frac{1}{3}$th.
6. 1st phalangeal joints	1	1·3	„ $\frac{1}{9}$th.
7. Middle of 2nd phalanges	1	1·125	under $\frac{1}{8}$th.
8. 2nd phalangeal joints	1	·8	„ $\frac{2}{3}$ths.
9. Middle of last phalanges	1	·725	over $\frac{1}{10}$th.

CENTRE.

Line.	Spots.	Mean.	Increase.
1. Base of metacarpus	1	4·8	
2. Middle of ditto	1	4·1	about $\frac{1}{6}$th.
3. Heads of ditto	2	3·6	„ $\frac{1}{7}$th.
4. Clefts of fingers	2	2·275	„ $\frac{3}{8}$ths.
5. Between last and 1st phalangeal joints	2	1·7	„ $\frac{1}{2}$rd.
6. 1st phalangeal joints	2	1·4	over $\frac{1}{3}$th.
7. Middle of 2nd phalanges	2	1·2	$\frac{1}{4}$th.
8. 2nd phalangeal joints	2	·9	$\frac{1}{3}$rd.
9. Middle of last phalanges	2	·775	about $\frac{1}{8}$th.

ULNAR SIDE.

Line.	Spots.	Mean.	Increase.
1. Base of metacarpus	1	5·0	
2. Middle of ditto	1	4·0	$\frac{1}{4}$th.
3. Heads of ditto	1	2·7	about $\frac{1}{2}$.
4. Clefts of fingers	1	1·8	$\frac{1}{2}$.
5. Between last and 1st phalangeal joints	1	1·45	under $\frac{1}{4}$th.
6. 1st phalangeal joints	1	1·275	about $\frac{1}{4}$th.
7. Middle of 2nd phalanges	1	1·2	„ $\frac{1}{16}$th.
8. 2nd phalangeal joints	1	·8	$\frac{2}{3}$.
9. Middle of last phalanges	1	·725	over $\frac{1}{10}$th.

On the dorsum the middle and ring fingers do not accurately correspond; the principal difference in favour of the middle finger is met with on the proximal side of the first phalangeal joints; beyond this the sensibility of the fingers nearly corresponds.

1. In all of these lines, then, the centre is the least sensitive part of the dorsum, with the solitary exception of the first, the spot of lowest sensibility of the whole hand being found to lie over the base of the fifth metacarpal bone. With a trifling exception, scarcely worth noticing, the sensibility of corresponding spots on the index and little fingers is either in favour of the index or no difference is perceptible at all.

2. The most rapid rate of increase is noticed on the little finger and the corresponding part of the metacarpal region; the least rapid on the index.

FINGERS.

I. Observations were made upon the four surfaces of each finger (their free portion) and upon their tips.

The mean sensibility of the four fingers, including their tips, is as follows:

Index finger,	mean of	24	spots,	·929.	in.
Middle	,,	23	,,	1·088	,,
Ring	,,	23	,,	1·132	,,
Little	,,	24	,,	1·037	,,

The borders of the digital portion of hand being its most sensitive parts (except the tips), it is found that the fingers which lie at the borders are also the most sensitive fingers on the whole. The index, little, middle, and ring finger, is the order of sensibility. The index finger exceeds the little finger by over one ninth, the middle finger by over one sixth, and the ring finger by over one fifth.

Surfaces of fingers.—As respects the palmar and dorsal surfaces of the four fingers, all that is necessary has already been said. I have merely to refer to their radial and ulnar sides, and to compare these together, and also with the palmar and dorsal surfaces.

Radial sides of fingers.—Their mean sensibility is as follows:

Index finger,	mean of	6	spots,	·804.	in.
Middle	,,	5	,,	·960	,,
Ring	,,	5	,,	1·065	,,
Little	,,	5	,,	1·095	,,

So that the radial sides of the fingers follow the same rule as the palmar surfaces, shading off in sensibility from the index, which is the most sensitive, to the little finger, whose radial side is the least sensitive. This side of the index exceeds the corresponding side of the middle finger by under one fifth, of the ring finger by under one third, of the little finger by over one third. These corresponding sides of the ring and little fingers differ little in sensibility.

Comparison of the radial sides of fingers with their palmar surfaces.—The radial sides of each of the two radial fingers (index and middle) exceed in sensibility their palmar surfaces. On the two other fingers the palmar surface exceeds the radial; thus—

The radial side of the index finger exceeds the palmar surface by about $\frac{1}{13}$th.
,, ,, middle finger ,, ,, $\frac{1}{12}$th.
The palmar surface of the ring finger exceeds the radial side by over $\frac{1}{8}$th.
,, ,, little finger ,, ,, a trifling amount.

The palmar surface and radial sides of the little finger are almost identical in sensibility.

Comparison of the radial sides of fingers with their dorsal surfaces.—On every finger the radial side is more sensitive than the dorsal surface, thus—

The radial side of the index finger exceeds the dorsal surface by under				$\frac{1}{8}$.
„	middle	„	„	„ $\frac{2}{3}$ths.
„	ring	„	„	„ $\frac{1}{3}$rd.
„	little	„	„	„ over $\frac{1}{10}$th.

The radial side of each, then, approaches in character the dorsal surface more and more as the fingers lie nearer and nearer to the ulnar side of the hand; it comes very much nearer to it on the little finger than on any of the others.

Ulnar sides of the fingers.—Their mean sensibility is as follows:

Index finger, mean of	5	spots,	·965	in.
Middle „	5	„	1·140	„
Ring „	5	„	1·120	„
Little „	6	„	·908	„

The ulnar side of the little finger entering into the formation of the border of the hand, which it is important should possess considerable tactile sensibility, is seen here, then, to be the most sensitive of all the fingers on their ulnar side. Next to it in order stands the index, which is superlatively the organ of touch, being so commonly used for this purpose separately from the other fingers. The ulnar sides of the middle and ring fingers nearly agree, as they do on their palmar and dorsal aspects. The little finger on this side exceeds the index in sensibility by about one sixteenth, and the ring finger by under one third. The index finger exceeds the middle and ring fingers by over one sixth.

Comparison of the ulnar sides of the fingers with their palmar surfaces.—The little finger (forming part of border of hand) here stands alone, for as the radial side of the index finger exceeds its palmar surface in sensibility, so the ulnar

side of the little finger is more sensitive than its palmar surface. In all the other fingers the palmar surface exceeds in sensibility their ulnar side. Thus—

The palmar surface of index finger exceeds the ulnar side by over $\frac{1}{8}$th.
" middle finger " " about $\frac{1}{8}$th.
" ring finger " " over $\frac{1}{11}$th.
The ulnar side of the little finger exceeds the palmar surface by under $\frac{1}{6}$th.

Comparison of the ulnar sides of the fingers with their dorsal surfaces.—On each of the fingers the ulnar side is more sensitive than their dorsal surface. Thus—

The ulnar side of the index finger exceeds the dorsal surface by under $\frac{1}{4}$th.
" middle finger " " about $\frac{1}{5}$th.
" ring finger " " over $\frac{1}{4}$th.
" little finger " " $\frac{1}{3}$rd.

The nearest approach to the character of the dorsal surface is met with, then, on the middle finger, and the greatest difference on the little finger.

Comparison of the radial and ulnar sides of each finger.—The little finger here stands alone. The importance of giving high sensibility to the border of the hand has caused a concentration of its sensibility upon its ulnar side, so that it is the only finger in which the sensibility of this side exceeds that of the radial. In all the others the radial exceeds the ulnar side. Thus—

The radial side of the index finger exceeds the ulnar side by $\frac{1}{2}$th.
" middle finger " " under $\frac{1}{2}$th.
" ring finger " " about $\frac{1}{10}$th.
The ulnar side of the little finger exceeds the radial side by over $\frac{1}{3}$th.

The little use which is made of the sides of the ring finger make their sensibility of but little importance. The radial and ulnar sides, then, differ very slightly, both being comparatively low in the scale of sensibility. The radial side of the little finger is of no importance at all compared with the side which enters into the formation of the border of the hand.

Sensibility of the interspaces of the fingers; comparison of opposing sides.—As a body sufficiently small may be

placed between the fingers in any of the three interspaces, this relation must not be overlooked.

	Ulnar side of		Radial side of		Sum of means.
1st interspace.	Index finger	·965 ...	middle finger	·960	1·925.
2nd ,,	Middle ,,	1·140 ...	ring ,,	1·065	2·205.
3rd ,,	Ring ,,	1·120 ...	little ,,	1·095	2·215.

The second and third interspaces pretty nearly agree in sensibility. The first exceeds them by over one seventh. A body placed in the interval between the index and middle fingers, then, would be felt better than when placed between the other fingers. In each interval the opposing radial side of the fingers forming it is the more sensitive. In the first interspace, however, the two opposing sides nearly agree in sensibility.

Tips of fingers.—In my hand the sensibility of the tips of the fingers is as follows:

Index finger	·35 in.
Middle ,,	·4 ,,
Ring ,,	·45 ,,
Little ,,	·4 ,,

Weber represents "the tip of the third finger" (? middle) as the most sensitive. Valentin gives the predominance to that of the index. In my own hand the index is unquestionably the most sensitive at the tip. In this it merely corresponds with the general character of the finger. It is the finger the extremity of which we most commonly and instinctively employ alone to determine the physical qualities of any substance to which the sense of touch is applicable. The lowest sensibility is seated at the tip of the ring finger, which, except in conjunction with the other fingers is rarely used for this purpose. The tip of the middle finger is commonly used in conjunction with that of the index, and a somewhat higher sensibility of the tip of the little finger appears to be imparted to it, as forming, as it were, the extremity of the border of the hand.

II. As with the hand at large, so with each finger, the sensibility gradually increases from the attachment of the

fingers towards their extremities. This also may in each finger be studied in zones, formed by anatomically analogous parts, and also upon each surface.

Sensibility of zones formed by corresponding parts of fingers, from their attachment to distal extremities. The numbers within parentheses indicate the corresponding zones in the tables given with respect to the hand at large:

INDEX.

Zones.		Mean of	Increase.
(4)	1. Clefts of fingers	3 spots, 1·336	
(5)	2. Between last and 1st phalangeal joint	4 ,, 1·225	about $\frac{1}{11}$th.
(6)	3. 1st phalangeal joint	4 ,, 1·062	over $\frac{1}{6}$th.
(7)	4. Middle of 2nd phalanx	4 ,, ·875	,, $\frac{1}{5}$th.
(8)	5. 2nd phalangeal joint	4 ,, ·693	,, $\frac{1}{4}$th.
(9)	6. Middle of last phalanx	4 ,, ·606	about $\frac{1}{7}$th.
	Tip	·350	,, $\frac{3}{4}$ths.

MIDDLE.

Zones.		Mean of	Increase.
(4)	1. Clefts of fingers	2 spots, 1·700	
(5)	2. Between last and 1st phalangeal joint	4 ,, 1·475	over $\frac{1}{8}$th.
(6)	3. 1st phalangeal joint	4 ,, 1·268	about $\frac{1}{5}$th.
(7)	4. Middle of 2nd phalanx	4 ,, 1·056	,, $\frac{1}{5}$th.
(8)	5. 2nd phalangeal joint	4 ,, ·843	,, $\frac{1}{4}$th.
(9)	6. Middle of last phalanx	4 ,, ·662	over $\frac{1}{4}$th.
	Tip	·400	about $\frac{2}{3}$ths.

RING.

Zones.		Mean of	Increase.
(4)	1. Clefts of fingers	2 spots, 1·875	
(5)	2. Between last and 1st phalangeal joint	4 ,, 1·537	over $\frac{1}{8}$th.
(6)	3. 1st phalangeal joint	4 ,, 1·300	under $\frac{1}{5}$th.
(7)	4. Middle of 2nd phalanx	4 ,, 1·106	over $\frac{1}{6}$th.
(8)	5. 2nd phalangeal joint	4 ,, ·843	under $\frac{1}{4}$rd.
(9)	6. Middle of last phalanx	4 ,, ·675	about $\frac{1}{4}$th.
	Tip	·450	$\frac{1}{2}$.

LITTLE.

Zones.		Mean of	Increase.
(4)	1. Clefts of fingers	3 spots, 1·408	
(5)	2. Between last and 1st phalangeal joint	4 ,, 1·350	very trifling.
(6)	3. 1st phalangeal joint	4 ,, 1·156	about $\frac{1}{8}$th.
(7)	4. Middle of 2nd phalanx	4 ,, 1·056	over $\frac{1}{7}$th.
(8)	5. 2nd phalangeal joint	4 ,, ·825	,, $\frac{1}{4}$th.
(9)	6. Middle of last phalanx	4 ,, ·681	,, $\frac{1}{5}$th.
	Tip	·400	under $\frac{2}{3}$ths.

The rapid increase from the middle of the last phalanges to the tips of the fingers is here most marked; it is greatest

in those fingers which have the highest sensibility at the extremity.

The order of most acute sensibility of the fingers at large, viz., index, little, middle, and ring, is observed to be pretty accurately preserved in each zone. Now and then, however, the little and middle fingers agree in sensibility, and in one zone the middle and ring fingers agree. At the middle of the last phalanges, however, a different order is assumed, apparently preparatory to the final distribution of sensibility to their extremities, the order being index, middle, ring, little.

Comparison of anatomically analogous spots on radial sides of fingers.

Lines.		Index.	Increase.	Middle.	Increase.
(5)	2. Between clefts of fingers and 1st phalangeal joint	1·050		1·400	
(6)	3. 1st phalangeal joint	·825	about $\frac{2}{3}$ths.	1·175	under $\frac{1}{4}$th.
(7)	4. Middle of 2nd phalanx	·675	under $\frac{1}{4}$th.	·925	over $\frac{1}{4}$th.
(8)	5. 2nd phalangeal joint	·575	over $\frac{1}{6}$th.	·775	under $\frac{1}{4}$th.
(9)	6. Middle of last phalanx	·500	over $\frac{1}{7}$th.	·525	„ $\frac{1}{2}$.

Lines.		Ring.	Increase.	Little.	Increase.
(5)	2. Between clefts of fingers and 1st phalangeal joint	1·550		1·600	
(6)	3. 1st phalangeal joint	1·300	under $\frac{1}{3}$th.	1·250	about $\frac{2}{3}$ths.
(7)	4. Middle of phalanx	1·125	„ $\frac{1}{7}$th.	1·125	$\frac{1}{8}$th.
(8)	5. 2nd phalangeal joint	·775	„ $\frac{1}{2}$.	·850	about $\frac{1}{4}$rd.
(9)	6. Middle of last phalanx	·575	over $\frac{1}{3}$rd.	·650	under $\frac{1}{3}$rd.

Each corresponding spot, then, follows the general rule of gradation of sensitiveness from radial to ulnar side pretty accurately.

Comparison of anatomically analogous spots on the ulnar sides of the fingers.

Lines.		Index.	Increase.	Middle.	Increase.
(5)	2. Between clefts of fingers and 1st phalangeal joint	1·350		1·600	
(6)	3. 1st phalangeal joint	1·175	over $\frac{1}{4}$th.	1·400	$\frac{1}{4}$th.
(7)	4. Middle of 2nd phalanx	·925	about $\frac{2}{7}$ths.	1·150	over $\frac{1}{5}$th.
(8)	5. 2nd phalangeal joint	·725	„ $\frac{2}{7}$ths.	·900	„ $\frac{1}{4}$th.
(9)	6. Middle of last phalanx	·650	over $\frac{1}{9}$th.	·650	„ $\frac{1}{3}$rd.

Lines.		Ring.	Increase.	Little.	Increase.
(5)	2. Between clefts of fingers and 1st phalangeal joint .	1·600		1·100	
(6)	3. 1st phalangeal joint .	1·400	$\frac{1}{7}$th.	1·000	$\frac{1}{10}$th.
(7)	4. Middle of 2nd phalanx .	1·050	$\frac{1}{3}$rd.	·850	over $\frac{1}{8}$th.
(8)	5. 2nd phalangeal joint .	·900	$\frac{1}{6}$th.	·725	„ $\frac{1}{6}$th.
(9)	6. Middle of last phalanx .	·650	over $\frac{1}{3}$rd.	·650	„ $\frac{1}{9}$th.

In these tables, while the general rule as to the order of sensitiveness of these surfaces generally holds good, the following points are worthy of observation :—1st. That in the two most distal spots the index and little fingers actually coincide, while in the more proximal the little exceeds the index in sensibility. 2nd. That in all the spots, with one trifling exception, the ring and middle fingers agree. 3rd. That in the last spot the fingers all agree in sensitiveness. This last point appears to be related to the shape of the extremity of the hand from the different lengths of the fingers, bringing the ulnar side of the last phalanx of the ring finger into the formation of the border or extremity of the hand.

Comparison of sides and surfaces of each finger at each zone, arranging the sides and surfaces at each zone in the order of sensitiveness.

Zones.		Index. Surfaces.		Excess over succeeding surface.	Middle. Surfaces.		Excess over succeeding surface.
(5)	2. Between clefts of fingers and 1st phalangeal joints.	Palmar	1·050	$\frac{2}{7}$ths.	Palmar	1·250	under $\frac{1}{6}$th.
		Radial	1·050	$\frac{2}{7}$ths.	Radial	1·400	$\frac{1}{4}$th.
		Ulnar	1·350	$\frac{1}{13}$th.	Ulnar	1·600	trifling.
		Dorsal	1·450		Dorsal	1·650	
		Ring.			Little.		
		Palmar	1·250	under $\frac{1}{4}$th.	Ulnar	1·100	under $\frac{1}{7}$th.
		Radial	1·550	trifling.	Palmar	1·250	„ $\frac{1}{5}$th.
		Ulnar	1·600	over $\frac{1}{11}$th.	Dorsal	1·450	over $\frac{1}{10}$th.
		Dorsal	1·750		Radial	1·600	

Zone.
(6) 3. 1st phalangeal joints.

INDEX.

Surfaces.		Excess over succeeding surface.
Radial	·825	over $\frac{1}{7}$th.
Palmar	·950	under $\frac{1}{4}$th.
Ulnar	1·175	under $\frac{1}{9}$th.
Dorsal	1·300	

MIDDLE.

		Excess over succeeding surface.
Palmar	1·100	trifling.
Radial	1·175	under $\frac{1}{5}$th.
Ulnar	1·400	
Dorsal	1·400	

RING.

Palmar	1·100	under $\frac{1}{5}$th.
Radial	1·300	$\frac{1}{13}$th.
Ulnar	1·400	
Dorsal	1·400	

LITTLE.

Ulnar	1·000	$\frac{1}{18}$th.
Palmar	1·100	under $\frac{1}{11}$th.
Radial	1·250	trifling.
Dorsal	1·275	

Zone.
(7) 4. Middle of 2nd phalanges.

INDEX.

Surfaces.		Excess over succeeding surface.
Radial	·675	over $\frac{1}{7}$th.
Palmar	·775	under $\frac{1}{5}$th.
Ulnar	·925	over $\frac{1}{5}$th.
Dorsal	1·125	

MIDDLE.

		Excess over succeeding surface.
Radial	·925	trifling.
Palmar	1·000	over $\frac{1}{7}$th.
Ulnar	1·150	
Dorsal	1·150	

RING.

Palmar	1·000	trifling.
Ulnar	1·050	$\frac{1}{14}$th.
Radial	1·125	$\frac{1}{9}$th.
Dorsal	1·250	

LITTLE.

Ulnar	·850	under $\frac{1}{4}$th.
Palmar	1·050	$\frac{1}{14}$th.
Radial	1·125	over $\frac{1}{11}$th.
Dorsal	1·200	

Zone.
(8) 5. 2nd phalangeal joints.

INDEX.

Surfaces.		Excess over succeeding surface.
Radial	·575	over $\frac{1}{9}$th.
Palmar	·675	about $\frac{1}{13}$th.
Ulnar	·725	over $\frac{1}{10}$th.
Dorsal	·800	

MIDDLE.

Surfaces.		Excess over succeeding surface.
Radial	·775	trifling
Palmar	·800	$\frac{1}{8}$th.
Ulnar	·900	
Dorsal	·900	

RING.

Radial	·775	trifling.
Palmar	·800	$\frac{1}{8}$th.
Ulnar	·900	
Dorsal	·900	

LITTLE.

Ulnar	·725	over $\frac{1}{10}$th.
Dorsal	·800	$\frac{1}{12}$th.
Radial	·850	about $\frac{1}{11}$th.
Palmar	·925	

Zone.

(9) 6. Middle of last phalanges.

Index.			Middle.		
Surfaces.		Excess over succeeding surface.	Surfaces.		Excess over succeeding surface.
Radial	·500	$\frac{1}{10}$th.	Radial	·525	$\frac{1}{8}$th.
Palmar	·550	over $\frac{1}{6}$th.	Ulnar	·650	$\frac{1}{13}$th.
Ulnar	·650	„ $\frac{1}{9}$th.	Palmar	·700	under $\frac{1}{9}$th.
Dorsal	·725		Dorsal	·775	
Ring.			**Little.**		
Radial	·575	over $\frac{1}{8}$th.	Ulnar	·650	
Ulnar	·650	$\frac{1}{13}$th.	Radial	·650	$\frac{1}{13}$th.
Palmar	·700	under $\frac{1}{9}$th.	Palmar	·700	trifling.
Dorsal	·775		Dorsal	·725	

But few remarks are needed with respect to the above table.—1. On the index finger in each zone, the order of sensibility on the surfaces is, radial, palmar, ulnar, and dorsal, the only exception being that in the proximal zone the radial and palmar surfaces coincide. 2. On the middle finger the superiority in sensibility of the radial side over the others is only observable from the first phalangeal joints onwards. When the radial side becomes the most sensitive, the palmar surface comes second in order, until arriving at the last zone, when the ulnar side takes precedence of it. In all but the proximal and distal zones the ulnar and dorsal surfaces coincide. This renders the high position of the ulnar in the last zone more remarkable. 3. On the ring finger it is still later that the radial side acquires pre-eminence, viz., at the penultimate zone. Until this happens the palmar stands highest, and subsequently second. Both on this finger and on the middle there appears a tendency for the ulnar side to rise in the scale; here too in the last zone, and also in the antepenultimate zone, it stands second, in the former being above the palmar, and in the latter above the radial. 4. On the little finger this predominance of the ulnar side is confirmed. It throughout takes the first rank. In the three proximal zones the palmar stands next to it, but in the last two it is either lowest in sensibility or is not far removed from the lowest. In the last zone the radial side, which

had previously stood lowest or next to the lowest in sensibility, rises to the second place, next to the ulnar. It is worthy of remark, first, that in every zone in each finger, with the exception of two on the little finger, the dorsal surface stands last and lowest in sensibility; and next, that at the last zones (middle of last phalanges) of every finger, except the index, the radial and ulnar sides are more sensitive than the palmar surface

A study of the columns headed "Excess of sensibility over succeeding surface," will show how gradually any variation in the order of pre-eminence on proceeding from the base towards the tip is effected.

Thumb.

In the previous portions of this inquiry I have found it convenient, for the most part, to discard the thumb from my calculations, and this mainly on the ground of simplicity in my statements. It is incumbent upon me now to enter upon a separate consideration of this organ, peculiar in its anatomy, in its attachment to the carpus, and in its opposability to other portions of the hand. In doing this, however, it will be necessary to take again into consideration the sensibility of certain spots upon its surface which have already been considered in other relations.

Thumb as a whole.—Its general sensibility, including its metacarpal and free portions, may thus be stated;—Mean sensibility of 25 spots, 1·529 in.

If we regard the thumb as destitute of a metacarpal bone, and as framed upon three bones analogous to phalanges, we may compare this mean with that of the fingers (including metacarpo-phalangeal joints and tips), on which view it is represented as less sensitive than any of them.

The sensibility of—					Excess over that of thumb.
Index finger thus represented is, mean of	27	spots,	1·012	in.	over $\frac{1}{2}$.
Middle finger	25	„	1·205	.	under $\frac{1}{3}$rds.
Ring finger	25	„	1·254	.	over $\frac{1}{3}$rd.
Little finger	27	„	1·155	.	„ $\frac{1}{4}$rd.

It will be observed that by thus including the metacarpo-phalangeal joints, the order of sensibility is the same as when they are excluded.

Surfaces, *from carpal attachment to extremity.*—*Palmar surface* (*excluding tip*).—Mean sensibility of 6 spots, 1·262 in.

This surface is comparable with the palmar surface of the other fingers, including their metacarpo-phalangeal joints. Thus—

				Excess over sensibility of thumb.
Index finger thus represented,	mean of 7 spots,	·957 in.		under $\frac{1}{3}$rd.
Middle finger	„ „ 7 „	1·107	.	„ $\frac{1}{4}$th.
Ring finger	„ „ 7 „	1·107	.	„ $\frac{1}{4}$th.
Little finger	„ „ 7 „	1·146	.	„ $\frac{1}{10}$th.

It is, therefore, lower in sensibility than the corresponding parts of any of the other fingers.

It will be observed that, thus including the metacarpo-phalangeal joints, the order of sensibility of the above four fingers is the same as when they are excluded.

Dorsal surface.—Mean sensibility of 6 spots, 1·741 in.

This surface is comparable with the dorsal surface of the other fingers, including their metacarpo-phalangeal joints. Thus—

				Excess of sensibility over that of thumb.
Index finger thus represented,	mean of 7 spots,	1·328 in.		under $\frac{1}{3}$rd.
Middle finger	„ „ 7 „	1·639	.	about $\frac{1}{10}$th.
Ring finger	„ „ 7 „	1·746	.	none.
Little finger	„ „ 7 „	1·421		under $\frac{1}{4}$th.

The dorsal surface of the thumb thus agrees very closely with the corresponding part of the ring finger, of the finger whose dorsal surface is least sensitive of the four.

Here, too, the inclusion of the metacarpo-phalangeal joints does not affect the order of sensibility of the four fingers.

Radial side.—Mean sensibility of 6 spots, 1·120 in.

This surface may be compared with the radial side of the index finger, including the metacarpo-phalangeal joint. Thus—

Index finger thus represented, mean of 7 spots, ·882; excess over sensibility of thumb, under $\frac{1}{3}$ths.

But to compare with the other fingers, the carpo-metacarpal joint of thumb must be excluded. Thus—

Thumb, mean sensibility of 5 spots, 1·185 in.

		Excess over sensibility of thumb.
Middle finger, mean of 5 spots,	·960 in.	under $\frac{1}{4}$th.
Ring finger „ 5 „	1·065 .	over $\frac{1}{9}$th.
Little finger „ 5 „	1·095 .	under $\frac{1}{12}$th.

In all these instances the radial side of the thumb is below the sensibility of the radial sides of the other fingers.

Ulnar side.—Mean sensibility of 6 spots, 1·858 in.

The surface may be compared with the ulnar side of the little finger, including its metacarpo-phalangeal joint. Thus :

Little finger thus represented, mean of 7 spots, ·964, nearly twice the sensibility of the thumb.

But to compare with the other fingers, the carpo-metacarpal joint of thumb must be excluded. Thus—

Thumb, mean sensibility of 5 spots, 1·500.

		Excess of sensibility over that of thumb.
Index finger, mean of 5 spots,	·965 in. .	under $\frac{2}{3}$rds.
Middle finger „ 5 „	1·140 .	„ $\frac{1}{3}$rd.
Little finger „ 5 „	1·120 .	„ $\frac{1}{3}$rd.

It thus is exceeded in sensibility by all the other fingers.

Comparison of the above surfaces among themselves.—The order of sensibility of the surfaces of the thumb, then, is, palmar surface, radial side, dorsal surface, and ulnar side. Thus—

The palmar surface exceeds the	radial side	in sensibility by over	$\frac{1}{3}$th.
The radial side „	dorsal surface	„	under $\frac{1}{4}$th.
The dorsal surface „	ulnar side	„	about $\frac{1}{15}$th.

Metacarpal Portion.—Sensibility of the metacarpal portion, including metacarpo-phalangeal joint, mean of 12 spots, 2·200 in.

If we compare this with the first phalanges of the fingers, including in the latter their metacarpo-phalangeal joints and the first phalangeal joints, we find the following results :

				Excess of sensibility over thumb.
The above portion of the index finger, mean of	14	spots,	1·307 in.	over $\frac{2}{3}$rds.
„ middle finger	12	„	1·622	„ $\frac{1}{3}$rd.
„ ring finger	12	„	1·700	under $\frac{1}{4}$rd.
„ little finger	14	„	1·425	over $\frac{1}{2}$.

So that the excess of the analogous parts of the fingers over this portion of the thumb is considerable.

Comparison of the palmar surface of the metacarpal portion of the thumb with the palmar surface of the analogous parts of the fingers.—

Palmar surface of metacarpal portion of thumb, mean of 3 spots, 1·666 in.

Palmar surface of analogous part (1st phalangeal) of—				Excess over thumb.
Index finger, mean of	4	spots,	1·175 in.	under $\frac{1}{2}$.
Middle finger	4	„	1·312	over $\frac{1}{4}$th.
Ring finger	4	„	1·312	„ $\frac{1}{4}$th.
Little finger	4	„	1·337	under $\frac{1}{4}$th.

So that in every finger this part exceeds the sensibility of the metacarpo-palmar surface of thumb. That it should do so is in accordance with the former being mostly free and the latter not free, and with the comparatively low sensibility of the adjoining part of the palm of the hand. It is less used for palpation than the fingers, only coming in contact with bodies which are grasped.

Comparison of dorsal surface of the metacarpal portion of the thumb with the dorsal surface of the analogous parts of the fingers.—

Dorsal surface of the metacarpal portion of thumb, mean of 3 spots, 2·300 in.

Dorsal surface of analogous part (1st phalangeal) of—				Excess over thumb.
Index finger, mean of	4	spots,	1·662	over $\frac{3}{5}$ths.
Middle finger	4	„	2·162	about $\frac{1}{10}$th.
Ring finger	4	„	2·325	nearly the same sensibility.
Little finger	4	„	1·806	over $\frac{1}{4}$th.

While, then, the sensibility of the dorsal surface of this part agrees nearly with that of the analogous part of the ring finger, it is considerably lower than that of the other fingers.

Comparison of the radial side of the metacarpal portion of the thumb with that of the analogous parts of the fingers.—

Radial side of metacarpal portion of thumb, mean of 3 spots, 2·066 in.

This may be compared with the index finger:—

Radial side of analogous (1st phalangeal) part of index finger, mean of 4 spots, 1·106; excess over thumb, over $\frac{3}{8}$ths.

But for comparison with the other fingers, the carpo-metacarpal joint must be excluded. Thus—

Radial side of metacarpal portion of thumb, mean of 2 spots, 1·800 in.

Radial side of analogous part of—				Excess of sensibility over thumb.
Middle finger,	mean of 2	spots,	1·287	about $\frac{2}{13}$ths.
Ring finger	„ 2	„	1·425	over $\frac{1}{3}$th.
Little finger	„ 2	„	1·425	over $\frac{1}{4}$th.

So that the excess is here again considerably in favour of all the other fingers.

Comparison of the ulnar side of the metacarpal portion of the thumb with that of the analogous parts of the fingers.—

Ulnar side of metacarpal portion of thumb, mean of 3 spots, 2·766.

This may be compared with the little finger:

Ulnar side of analogous (1st phalangeal) part of little finger, mean of 4 spots, 1·131, or $2\frac{1}{2}$ times that of thumb.

But for comparison with the other fingers, the carpo-metacarpal joint must be excluded. Thus—

Ulnar side of metacarpal portion of thumb, mean of 2 spots, 2·350 in.

Ulnar side of analogous (1st phalangeal) part of—				
Index finger,	mean of 2	spots, 1·262;	excess over thumb,	about $\frac{3}{8}$ths.
Middle finger	„ 2	„ 1·500	„	under $\frac{3}{8}$ths.
Ring finger	„ 2	„ 1·500	„	„ $\frac{3}{8}$ths.

The difference in favour of the fingers is greater here than on any other surface.

Comparison of surfaces of metacarpal portion of thumb with one another.—The order of sensitiveness is the same as in the thumb at large.

The palmar surface exceeds the radial side in sensibility by under $\frac{1}{4}$th.
The radial side ,, dorsal surface ,, about $\frac{1}{9}$th.
The dorsal surface ,, ulnar side ,, ,, $\frac{1}{5}$th.

Free portion of thumb.—Mean sensibility, including tip, mean of thirteen spots, ·909 in.

This may be compared with that of analogous parts of fingers, all beyond first phalangeal joints:

					Excess over sensibility of thumb.
The above part of index finger, mean of	13	spots,	·696	.	under $\frac{1}{3}$rd.
,, middle finger ,,	13	,,	·819	.	about $\frac{1}{9}$th.
,, ring finger ,,	13	,,	·842	.	,, $\frac{1}{12}$th.
,, little finger ,,	13	,,	·819	.	,, $\frac{1}{9}$th.

So that here, too, as in the metacarpal portion, the sensibility of the thumb is less than that of any of the fingers.

Comparison of the palmar surface of the free portion of the thumb with the palmar surface of the analogous portions of the fingers.—

Palmar surface of free portion of thumb, mean of 3 spots, ·858 in.

Palmar surface of analogous part (3 last zones) of—
Index finger, mean of 3 spots, ·666, exceeds sensibility of thumb by about $\frac{2}{3}$ths.
Middle finger ,, 3 ,, ·833 ,, a trifle.
Ring finger ,, 3 ,, ·833 ,, ,,
Little finger ,, 3 ,, ·891, exceeded slightly by thumb.

So that the palmar surface of this part of the thumb agrees pretty nearly with that of the last three fingers in their analogous parts, but is exceeded slightly by analogous part of index. On the whole, then, its sensibility is high.

Comparison of the dorsal surface of the free portion of the thumb with the dorsal surface of analogous portions of the fingers.—

Dorsal surface of free portion of thumb, mean of 3 spots, 1·183 in.

Dorsal surface of analogous part (3 last zones) of—
Index finger, mean of 3 spots, ·883, exceeds thumb by about $\frac{2}{3}$ths.
Middle finger ,, 3 ,, ·941 ,, over $\frac{1}{4}$th.
Ring finger ,, 3 ,, ·975 ,, about $\frac{1}{9}$ths.
Little finger ,, 3 ,, ·908 ,, under $\frac{1}{3}$rd.

The difference is here also, to some extent, in favour of the fingers.

Comparison of the radial side of the free portion of the thumb with the radial side of the analogous portions of the fingers.—

Radial side of free portion of thumb, mean of 3 spots, ·775 in.

Radial side of analogous part (3 last zones) of—

Index finger,	mean of 3 spots,	·583,	exceeds thumb by about	$\frac{1}{3}$rd.	
Middle finger	„ 3 „	·741	„	trifling amount.	
Ring finger	„ 3 „	·825,	is exceeded by thumb by about	$\frac{1}{15}$th.	
Little finger	„ 3 „	·875	„	over $\frac{1}{8}$th.	

The radial side of the free portion of the thumb thus possessing a high sensibility, stands next in rank to that of the middle finger in its analogous part, and above that of the ring and little fingers.

Comparison of the ulnar side of the free portion of the thumb with the ulnar side of the analogous portions of the fingers.—

Ulnar side of free portion of thumb, mean of 3 spots, ·950 in.

Ulnar side of analogous part (3 last zones) of—

Index finger,	mean of 3 spots,	·766,	exceeds thumb by about	$\frac{1}{4}$th.	
Middle finger	„ 3 „	·900	„	$\frac{1}{18}$th.	
Ring finger	„ 3 „	·866	„	under $\frac{1}{10}$th.	
Little finger	„ 3 „	·741	„	about $\frac{2}{7}$ths.	

The differenee here, too, is in favour of the other fingers, but the ulnar side of the thumb is not far behind that of the middle finger in sensibility.

Comparison of the above surfaces of free portion of thumb among themselves.—In this portion of the thumb the order of sensibility of the surfaces is different from that on the metacarpal portion, and resembles that of the index and middle fingers. The radial side has the highest sensibility, and the other sides follow in the order, palmar surface, ulnar side, dorsal surface. Thus—

The radial side	exceeds the	palmar surface	in sensibility by under	$\frac{1}{9}$th.
The palmar surface	„	ulnar side	„	„ $\frac{1}{9}$th.
The ulnar side	„	dorsal surface	„	„ $\frac{1}{4}$th.

So that the dorsal side is by far the least sensitive.

TIP OF THUMB.—This is less sensitive than the tip of any of the other fingers. It is ·525 in.

COMPARATIVE SENSIBILITY OF PROXIMAL AND DISTAL PARTS OF THUMB.—*Comparison of metacarpal and free portions.*—The free portion exceeds the metacarpal in sensibility. It is $2\frac{1}{2}$ times as sensitive. This is a much greater difference than exists between the corresponding parts of the other fingers. Thus—

The more distal part of index and middle fingers is not quite twice as sensitive as that which is analogous to the metacarpal portion of thumb.
The more distal part of ring finger is about twice as sensitive as that which is analogous to the metacarpal portion of thumb.
The more distal part of little finger exceeds the proximal part by $\frac{3}{4}$ths.

Comparison of palmar surfaces of metacarpal and free portions.—On the palmar surface the free portion is nearly twice as sensitive as the metacarpal. This is a greater difference than exists between corresponding parts of the other fingers. Thus—

The more distal part of index finger exceeds the part analogous to the metacarpal of thumb by under $\frac{3}{8}$ths; middle and ring finger, by about $\frac{1}{4}$ths; little finger, by $\frac{1}{2}$.

Comparison of dorsal surfaces of metacarpal and free portions.—On this surface, also, the free portion is nearly twice as sensitive as the metacarpal. Here the difference is mostly less than between corresponding parts of the other fingers. Thus—

The more distal part of index finger exceeds the part analogous to the metacarpal of thumb by about $\frac{2}{5}$ths.
The more distal part of middle finger is $2\frac{1}{7}$ times as sensitive as part analogous to the metacarpal of thumb; ring finger is about $2\frac{1}{3}$rd; little finger, about twice.

Comparison of radial sides of metacarpal and free portions.—Here the free portion is $2\frac{2}{7}$th times as sensitive as the metacarpal portion. This is a greater difference than exists between the corresponding parts of other fingers. Thus—

The more distal part of index finger is not quite twice as sensitive as that analogous to the metacarpal of thumb.
The more distal part of middle finger exceeds that analogous to the metacarpal of thumb by about $\frac{1}{7}$ths; ring finger, by $\frac{3}{4}$ths; little finger, by $\frac{5}{8}$ths.

Comparison of ulnar side of metacarpal and free portions.—On this side the free portion is nearly three times as sensitive as the metacarpal. No approach to this difference is noticeable between the corresponding parts of the other fingers. Thus—

The more distal part of index finger exceeds that analogous to the metacarpal of thumb by about $\frac{1}{7}$ths; middle finger, by $\frac{2}{3}$rds; ring finger, by $\frac{3}{4}$ths; little finger, by about $\frac{1}{2}$.

So, then, the greatest difference between the metacarpal and free portions of the thumb is found on the ulnar side, and the next greatest difference on the radial side. It is only on the dorsal surface that the difference is to a less extent than is found existing on the other fingers; for the most part it is much greater.

Comparison of zones, &c., from base to distal extremity of thumb.—The following table will enable me to represent this comparison. The surfaces in each zone are arranged in order of highest sensibility.

Zone.	Surface.		Excess over succeeding surface.	Excess over same surface in preceding zone.
1. Base of metacarpus	Palmar	2·000	$\frac{8}{10}$ths	—
	Radial	2·600	trifling	—
	Dorsal	2·700	$\frac{1}{3}$rd	—
	Ulnar	3·600	—	—
	Mean	2·725		
2. Middle of metacarpus	Palmar	1·700	$\frac{5}{17}$ths	over $\frac{1}{6}$th
	Radial	2·200	$\frac{2}{11}$ths	$\frac{2}{11}$ths
	Dorsal	2·200	.	under $\frac{1}{4}$th
	Ulnar	2·600	.	$\frac{5}{13}$ths
	Mean	2·175		

Exceeds previous zone by over $\frac{1}{4}$th.

Zone.	Surface.		Excess over succeeding surface.	Excess over same surface in preceding zone.
3. Head of metacarpus	Palmar	1·300	$\frac{1}{13}$th	$\frac{4}{13}$ths
	Radial	1·400	$\frac{5}{7}$ths	$\frac{2}{7}$ths
	Dorsal	2·000	$\frac{1}{20}$th	$\frac{4}{10}$th
	Ulnar	2·100	.	under $\frac{1}{4}$th
	Mean	1·700		

Exceeds previous zone by under $\frac{2}{7}$ths.

4. Middle of 1st phalanx	Palmar	1·000	.	$\frac{3}{10}$ths
	Radial	1·000	$\frac{1}{4}$th	$\frac{3}{8}$ths
	Ulnar	1·250	under $\frac{1}{12}$th	over $\frac{3}{8}$rds
	Dorsal	1·350	.	. under $\frac{1}{2}$
	Mean	1·250		

Exceeds previous zone by over $\frac{1}{3}$rd.

5. Phalangeal joint	Radial	·725	. over $\frac{1}{6}$th	. over $\frac{1}{3}$rd
	Palmar	·850	under $\frac{1}{6}$th	. over $\frac{1}{9}$th
	Ulnar	·950	over $\frac{1}{4}$th	under $\frac{1}{3}$rd
	Dorsal	1·200	.	. $\frac{1}{6}$th
	Mean	·931		

Exceeds previous zone by over $\frac{1}{5}$rd.

6. Middle of last phalanx	Radial	·600	$\frac{1}{12}$th	over $\frac{1}{3}$th
	Ulnar	·650	under $\frac{1}{3}$th	. under $\frac{1}{3}$
	Palmar	·725	over $\frac{1}{3}$rd	over $\frac{1}{6}$th
	Dorsal	1·000	.	. $\frac{1}{3}$th
	Mean	·743		

Exceeds previous zone by over $\frac{1}{4}$th.

In the above table the rate of increase in sensibility is seen to be greatest after leaving the connected part of the thumb. The gradual increase in sensibility of each surface from the base to the last phalanx is readily traceable; and, as in a former table relating to the fingers, the steady increase by which, zone after zone, the ulnar side acquires its ultimate high position of sensibility, from being the least sensitive at the base, is easily seen. In other respects the table speaks for itself.

I must postpone to some future communication the con-

sideration of the results obtained by the application of the compasses in the long axis of the hand and transversely to it. The numbers upon which any subsequent remarks will be founded, I have, however, thought it best to include in the table which constitutes the appendix to the present paper.

General Summary.

1. Expressed in inches and parts of an inch, the sensibility of the hand, as ascertained by Weber's method, is 1·384. The extremes are 5 in. and ·35 in. These numbers represent the sum of two measurements, one transverse and the other vertical.

2. The order of highest sensibility of the several surfaces and borders of the hand, as a whole, differs somewhat according as the thumb is included in the calculation or excluded. 1st. Including the thumb, the order is, distal extremity, radial border, ulnar border, palmar surface, dorsal surface. 2nd. Excluding the thumb, it is, distal extremity, palmar surface and ulnar border, radial border, dorsal surface.

3rd. The sensibility of the hand, and of all parts of the hand, increase, gradually, but at a varying rate, from the wrist to the extremity. This is seen when we compare the numbers expressing the mean sensibility of the metacarpal and digital portions of the hand and of their several surfaces and borders, or when we compare zone after zone of anatomically corresponding parts, proceeding from the base towards the extremity, or, lastly, when each finger is examined separately.

4. The surfaces and borders of the metacarpal and digital portions being examined separately, it appears—1st. In the metacarpal region—(*a*) including the thumb, the order of sensibility is, radial border, palmar surface, ulnar border, dorsal surface; (*b*) excluding the thumb, the order is, palmar surface, ulnar border, radial border, dorsal surface. 2nd. In the digital region the order is, radial border, ulnar border, palmar surface, dorsal surface.

5. Comparing successive zones formed by anatomically

corresponding parts, the sensibility is seen to vary from the lowest at the base of the metacarpus, represented by 3·175 in., to ·680 in. at the middle of the last phalanges. The rate of increase from zone to zone is not uniform, but is most rapid immediately beyond the heads of the metacarpal bones, at which part, in fact, the fingers commence, although for a short distance they are connected by soft tissues. But the most rapid increase of all takes place from the middle of the last phalanges to the tips of the fingers. The same general facts are observed when the surfaces and borders of the hand and the fingers are separately examined.

6. Comparing the sensibility of the palmar and dorsal surfaces at each zone, it appears that the greatest difference between them is met with at the base of the metacarpus, but that this difference lessens steadily zone after zone as the distal extremity is approached.

7. The radial half of the hand, generally, exceeds the ulnar somewhat in sensibility. This same relation is found to exist when the radial and ulnar halves of the palmar and dorsal surfaces are separately examined.

8. In the proximal (metacarpal) portion, whether the thumb be included in the calculation or not, the radial half exceeds the ulnar half in sensibility much more than is observed in the distal (digital) portion.

9. On the palmar aspect of the proximal portion—(*a*) if the thumb be included in the calculation, the difference in favour of the radial half is still observed, but it is less than the average difference when all the surfaces are considered; but if (*b*) the thumb be excluded, and only the part of the palm of the hand in the rear of the four fingers be examined, the difference of sensibility is rather in favour of the ulnar half.

10. The most marked difference in favour of the radial side is found upon the dorsum. It comes out most strongly when the thumb is included in the calculation.

11. In the metacarpal region the greatest difference by far between the palmar and dorsal surfaces is met with on the ulnar half of the hand.

12. In the distal (digital) portion of the hand the pre-eminence of the radial side in sensibility is not very great on the palmar surface, and it is very much less upon the dorsal.

13. The difference in sensibility between the palmar and dorsal surface on the radial half of the digital portion (index and middle fingers) is more marked than on the ulnar half (little and ring fingers). But on both halves the amount of difference is less than is found in the proximal (metacarpal) region.

14. Omitting the thumb from calculation, and comparing the sensibility of the lateral halves at each zone, it appears that at the very base of the hand the difference is in favour of a higher sensibility on the ulnar side, but that this lessens on proceeding towards the heads of the metacarpal bones, where, as in all succeeding zones, the radial side becomes the more sensitive. This difference at the base in favour of the ulnar half is found to be limited to the palmar surface, for on the dorsal surface, wherever a difference of the two halves exists, it is always in favour of the radial half. But there is no difference on the dorsal surface at and beyond the second phalangeal joints.

15. On the palmar surface of the hand generally it may be said that the sensibility predominating on the radial side shades off towards the ulnar, and the same may be said generally of the dorsal surface. But this rule, thus expressed in general terms, calls for modification as different parts of the hand are examined. Thus—

16. Again omitting the thumb in the metacarpo-palmar region, whatever difference there may be is in favour of the centre of the palm, and the sensibility lessens towards the sides, and especially towards the radial side. But in the metacarpo-dorsal region the converse of this is observed, for the centre is, on the whole, the least sensitive part, and the sensibility increases towards the sides, and especially towards the radial side.

17. But in the digito-palmar region the general rule hold good absolutely; the two central fingers (middle and

ring), however, agreeing completely in their sensibility. On the digito-dorsal surface the lowest sensibility is found upon the ring finger, and the highest upon the index, the middle finger being intermediate. It increases also upon the little finger, which stands in sensibility next in rank to the index.

18. On comparing the lateral and central parts of the hand in the several successive zones on the palmar aspect, it is found that in the two proximal zones the sensibility is lowest on the radial side (parts in rear of index finger), and increases towards the ulnar side, but that from the heads of the metacarpal bones onwards the sensibility in each zone is greatest on the index finger, and shades off towards the little finger. On the dorsal aspect, in the line of every zone the centre is the least sensitive part, with one exception, and that is the zone corresponding to the base of the metacarpus, where the spot of lowest sensibility (5 in.) found over the base of the fifth metacarpal bone.

19. The order of highest sensibility of the fingers, taken in the mean of each, is index, little, middle, ring. The mean sensibility of the index finger is ·929 in., and of the ring finger 1·132 in.

20. The superior sensitiveness of the index finger is apparent, whatever part or surface is compared with the corresponding part or surface of any other finger, with the exception of the ulnar side. The tip of the index finger is the most sensitive part of the hand—it is ·35 in.

21. The radial sides of the fingers, like the palmar surface, are less sensitive the further we go from the radial side of the hand. The ulnar side of the little finger is the most sensitive, and the sensibility is lower as we go further from the ulnar side of the hand; the exception to this is the index finger, whose ulnar side stands next in rank to that of the little finger.

22. The radial sides of all the fingers exceed their dorsal surfaces in sensibility, and on the index and middle fingers they are also more sensitive than the palmar.

23. The ulnar sides of all the fingers are more sensitive

than the dorsal surface, but only the ulnar side of the little finger is more so than the palmar surface.

24. On the little finger alone the ulnar side is more sensitive than the radial. In all the others it is the reverse.

25. The sensibility of adjoining sides of the fingers is such that any object would be felt better when placed in the interval between the index and middle fingers, than between any of the others.

26. The order of sensibility of the tips of the fingers, in my hand, is—index, middle and little, ring.

27. In each finger the most rapid increase in sensibility is met with after passing the middle of the second phalanx, but the most rapid increase of all is from the middle of the last phalanx to the tip of the finger.

28. The orders of sensibility of the fingers at large is observed to hold good for each zone examined; but at the middle of the last phalanges a somewhat different order is assumed, viz., index, middle, ring, little.

29. On comparing corresponding spots on the radial sides of the four fingers, the order of sensibility established for the whole of these sides holds good. The same observation, *mutatis mutandis*, holds good generally as to the ulnar side, but it is worthy of observation that on the two most distal spots the sensibility of the index and little fingers coincides; that in all the spots, with a trifling exception, the ring and middle fingers agree, and that in the last spot all the fingers possess the same amount of sensitiveness.

30. The order of sensitiveness of the several sides and surfaces of each finger is not the same at all parts of the finger, with the exception of the index. The order, however, is in no case suddenly changed; a gradual alteration can, in each instance, be established.

31. In estimating the sensibility of the thumb, and in comparing it with other parts of the hand, I have regarded it as a finger destitute of a metacarpal element. The whole organ, from the carpo-metacarpal articulation to the tip, has been regarded as the analogue of a finger from the meta-

carpo-phalangeal articulation onwards. The free portion of the thumb has been compared with the portion of the fingers from the second phalanges onwards.

32. The thumb is, on the whole, less sensitive than the least sensitive of the fingers. This observation is true also when the tip or any surface of the thumb is compared with the tip or any corresponding surface of the four fingers; the only modification requisite in this statement being that the dorsal surface of the thumb coincides in sensibility with the least sensitive dorsal surface of the fingers; *i. e.*, with that of the ring finger. It also holds good when the metacarpal and free portions are severally compared with the analogous parts of the fingers.

33. Taking the thumb as a whole, the order of sensibility of its surfaces is palmar, radial, dorsal, ulnar. The order is the same if we confine our observations to its proximal (metacarpal) element.

34. Taking the free portion of the thumb alone, the order of sensibility of its surface is radial, palmar, ulnar, dorsal; the last being far inferior to the other three.

35. Comparing the several surfaces of the free portion of the thumb with those of analogous parts of the four fingers, it appears that its dorsal and ulnar sides are, on the whole, of lower sensibility than the corresponding parts of the fingers; that the palmar surface is of comparatively high sensibility, being only slightly exceeded by that of the index finger, and that the radial surface stands next in rank to that of the middle finger.

36. The free portion of the thumb is more than twice as sensitive as its connected (metacarpal) portion. On the ulnar side the difference is most marked, the next greatest difference is found on the radial side.

Appendix.

Table showing the actual Tactile Sensibility of One Hundred and Forty-two Spots on the Right Hand of the Author as measured in two directions, with the sum of the measurements at each spot examined.

HAND.	Measurement in long axis.	Transverse measurement.	Transverse with tape.	Sum.
1.—*Palm* of hand (exclusive of elevation corresponding with muscles of thumb).				
Point corresponding with—				
—— base of 3rd and 4th metacarpal bones	·9	1·0	...	1·9
—— base of 2nd ditto	1·2	·8	...	2·0
—— base of 5th ditto	·9	·9	...	1·8
—— middle of 5th ditto	·9	·8	...	1·7
—— middle of interval between 3d and 4th metacarpal bones	·9	·9	...	1·8
—— middle of 2nd metacarpal bone	·9	1·0	...	1·9
—— 2nd metacarpo-phalangeal articulation in anterior transverse crease	·7	·8	...	1·5
—— 3rd ditto	·8	·8	...	1 6
—— 4th ditto	·8	·8	...	1·6
—— 5th ditto	·9	·8	...	1·7
Sum	8·9	8·6	...	17·5
Mean	·89	·86	...	1·75
2.—*Back of hand* (exclusive of metacarpal bone and muscles of thumb).				
Point corresponding with—				
—— base of 3rd and 4th metacarpal bones	2·8	1·8	2·0	4·8
—— base of 2nd ditto	2 5	1·5	1·6	4·1
—— base of 5th ditto	3·3	1·4	1·7	5·0
—— middle of 5th ditto	2·8	1·1	1·2	4·0
—— middle of interval between 3rd and 4th ditto	2·5	1·6	...	4·1
—— middle of 2nd ditto	2·2	1·4	...	3·6
—— 2nd metacarpo-phalangeal articulation	1·1	1·1	...	2·2
—— 3rd ditto	1·8	1·7	...	3·5
—— 4th ditto	2·0	1·7	...	3·7
—— 5th ditto	1·5	1·2	...	2·7
Sum	22·5	*	15·2	37·7
Mean	2·25	...	1·52	3·77

* Wherever a measurement has been made with the tape it is, in the adding up, assumed as the correct measurement.

THUMB.	Measurement in long axis.	Transverse measurement.	Transverse with tape.	Sum.
Thumb (including metacarpal portion and elevation on palm corresponding to adductor muscles).				
3.—*Palmar surface.*				
Point corresponding to middle of metacarpal bone (*i. e.* midway between point on outer side of metacarpal bone and middle of 2nd metacarpal bone)	1·0	·7	...	1·7
In crease corresponding to metacarpo-phalangeal joint	·8	·5	...	1·3
Point corresponding to middle of 1st phalanx	·65	·35	...	1·0
,, ,, phalangeal joint	·45	·4	...	·85
Midway between last and tip of thumb, middle of last phalanx	·4	·325	...	·725
Tip of thumb	·25	·275	...	·525
Sum	3·55	2·55	...	6·100
Mean	·591	·425	...	1·017
4.—*Dorsal surface.*				
Point corresponding to base of metacarpal bone	1·5	·9	1·2	2·7
,, ,, middle of ditto	1·1	1·0	1·1	2·2
,, ,, metacarpo-phalangeal joint	1·0	·8	1·0	2·0
,, ,, middle of 1st phalanx	·9	·45	...	1·35
,, ,, phalangeal joint	·7	·5	...	1·2
A little below nail	·55	·45	...	1·0
Sum	5·75	4·10	4·70	10·45
Mean	·958	...	·783	1·741
5.—*Radial surface.*				
Point corresponding to base of metacarpal bone	1·5	1·0	1·1	2·6
,, ,, middle of ditto	1·2	·8	1·0	2·2
,, ,, metacarpo-phalangeal joint	·85	·55	...	1·4
,, ,, middle of 1st phalanx	·65	·35	...	1·0
,, ,, phalangeal joint	·45	·275	...	·725
Side of nail corresponding to middle of last phalanx	·35	·25	...	·6
Sum	5·0	...	3·525	8·525
Mean	·833	...	·587	1·420

INDEX FINGER.	Measurement in long axis.	Transverse measurement.	Transverse with tape.	Sum.
THUMB (*continued*).				
6.—*Ulnar surface.*				
Point corresponding to base of metacarpal bone	2·3	1·3	...	3·6
,, ,, middle of ditto	1·4	1·2	...	2·6
,, ,, metacarpo-phalangeal joint	1·1	1·0	...	2·1
,, ,, middle of 1st phalanx	·8	·45	...	1·25
,, ,, phalangeal joint	·6	·35	...	·95
,, ,, middle of last phalanx	·4	·25	...	·65
Sum	6·6	4·55	...	11·15
Mean	1·1	·758	...	1·858
INDEX FINGER.				
7.—*Palmar surface.*				
Crease opposite cleft of fingers	·7	·5	...	1·2
Between last point and 1st phalangeal joint	·6	·45	...	1·05
1st phalangeal joint	·55	·4	...	·95
Middle of 2nd phalanx	·45	·325	...	·775
2nd phalangeal joint	·375	·3	...	·675
Middle of last phalanx	·3	·25	...	·55
Tip of finger	·15	·2	...	·35
Sum	3·125	2·425	...	5·550
Mean	·446	·346	...	·792
8.—*Dorsal surface.*				
Point opposite cleft of fingers	1·0	·7	...	1·7
Between last point and 1st phalangeal joint	·9	·55	...	1·45
1st phalangeal joint	·8	·5	...	1·3
Middle of 2nd phalanx	·7	·425	...	1·125
2nd phalangeal joint	·4	·4	...	·8
A little below nail	·4	·325	...	·725
Sum	4·2	2·900	...	7·100
Mean	·700	·483	...	1·183

MIDDLE FINGER.	Measurement in long axis.	Transverse measurement.	Transverse with tape.	Sum.
INDEX FINGER (*continued*).				
9.—*Radial surface* (forming part of outer margin of hand).				
Point corresponding to metacarpo-phalangeal articulation	·75	·6	. .	1·35
„ „ cleft of fingers and crease on palmar surface	·75	·45	...	1·20
Between last point and 1st phalangeal joint	·65	·4	...	1·05
1st phalangeal joint	·55	·275	...	·825
Middle of 2nd phalanx	·45	·225	...	·675
2nd phalangeal joint	·375	·2	...	·575
Middle of last phalanx	·3	·2	...	·5
Sum	3·825	2·350	...	6·175
Mean	·546	·335	...	·882
10.—*Ulnar surface.*				
Midway between cleft of finger and phalangeal joint	·8	·55	—	1·35
1st phalangeal joint	·8	·375	—	1·175
Middle of 2nd phalanx	·6	·325	—	·925
2nd phalangeal joint	·45	·275	—	·725
Middle of last phalanx	·4	·25	—	·65
Sum	3·05	1·775	—	4·825
Mean	·610	·355	—	·965
MIDDLE FINGER.				
11.—*Palmar surface.*				
Crease corresponding to cleft of fingers	·8	·5	...	1·3
Midway between last point and 1st phalangeal joint	·75	·5	...	1·25
1st phalangeal joint	·65	·45	...	1·1
Middle of 2nd phalanx	·6	·4	...	1·0
2nd phalangeal joint	·45	·35	...	·8
Middle of last phalanx	·4	·3	...	·7
Tip of finger	·175	·225	...	·4
Sum	3·825	2·725	...	6·55
Mean	·546	·389	...	·935

RING FINGER	Measurement in long axis.	Transverse measurement.	Transverse with tape.	Sum.
MIDDLE FINGER (*continued*).				
12.—*Dorsal surface.*				
Point corresponding to cleft of fingers	1·4	·7	...	2·1
Between last point and 1st phalangeal joint	1·1	·55	...	1·65
1st phalangeal joint	·9	·5	...	1·4
Middle of 2nd phalanx	·7	·45	...	1·15
2nd phalangeal joint	·45	·45	...	·9
A little below nail	·45	·325	...	·775
Sum	5·0	2·975	...	7·975
Mean	·833	·495	..	1·329
13.—*Radial side.*				
Midway between cleft of fingers and 1st phalangeal joint	·9	·5	...	1·4
1st phalangeal joint	·8	·375	...	1·175
Middle of 2nd phalanx	·6	·325	...	·925
2nd phalangeal joint	·5	·275	...	·775
Middle of last phalanx	·3	·225	...	·525
Sum	3·1	1·70	...	4·8
Mean	·624	·340	...	·960
14.—*Ulnar side.*				
Midway between cleft of fingers and 1st phalangeal joint	1·1	·5	...	1·6
1st phalangeal joint	1·0	·4	...	1·4
Middle of 2nd phalanx	·8	·35	...	1·15
2nd phalangeal joint	·6	·3	...	·9
Middle of last phalanx	·4	·25	...	·65
Sum	3·9	1·8	...	5·7
Mean	·780	·360	..	1·140
RING FINGER.				
15.—*Palmar surface.*				
Crease corresponding to cleft of fingers	·8	·5	...	1·3
Between last point and 1st phalangeal joint	·75	·5	...	1·25
1st phalangeal joint	·65	·45	...	1·1
Middle of 2nd phalanx	·6	·4	...	1·0
2nd phalangeal joint	·45	·35	...	·8
Middle of last phalanx	·4	·3	...	·7
Tip of finger	·2	·25	..	·45
Sum	3·85	2·75	...	6·60
Mean	·550	·392	...	·942

LITTLE FINGER.	Measurement in long axis.	Transverse measurement.	Transverse with tape.	Sum.
RING FINGER (*continued*).				
16.—*Dorsal surface.*				
Point corresponding to cleft of fingers	1·8	·65	...	2·45
Between last point and 1st phalangeal joint	1·2	·55	...	1·75
1st phalangeal joint	·9	·5	...	1·4
Middle of 2nd phalanx	·8	·45	...	1·25
2nd phalangeal joint	·5	·4	...	·9
A little below nail	·45	·325	...	·775
Sum	5·65	2·875	...	8·525
Mean	·941	·479	...	1·420
17.—*Radial side.*				
Midway between cleft of fingers and 1st phalangeal joint	1·0	·55	...	1·55
1st phalangeal joint	·9	·4	...	1·3
Middle of 2nd phalanx	·8	·325	...	1·125
2nd phalangeal joint	·5	·275	...	·775
Middle of last phalanx	·35	·225	...	·575
Sum	3·55	1·775	...	5·325
Mean	·710	·355	...	1·065
18.—*Ulnar side.*				
Midway between cleft of fingers and 1st phalangeal joint	1·1	·5	...	1·6
1st phalangeal joint	1·0	·4	...	1·4
Middle of 2nd phalanx	·7	·35	...	1·05
2nd phalangeal joint	·6	·3	...	·9
Middle of last phalanx	·4	·25	...	·65
Sum	3·8	1·8	...	5·6
Mean	·760	·360	...	1·120
LITTLE FINGER.				
19.—*Palmar surface.*				
Crease corresponding to cleft of fingers	·8	·5	...	1·3
Between last point and 1st phalangeal joint	·75	·5	...	1·25
1st phalangeal joint	·65	·45	...	1·1
Middle of 2nd phalanx	·65	·4	...	1·05
2nd phalangeal joint	·55	·375	...	·925
Middle of last phalanx	·4	·3	...	·7
Tip of finger	·175	·225	...	·4
Sum	3·975	2·75	...	6·725
Mean	·567	·392	...	·960

LITTLE FINGER.	Measurement in long axis.	Transverse measurement.	Transverse with tape.	Sum.
LITTLE FINGER (*continued*).				
20.—*Dorsal surface.*				
Point corresponding to cleft of fingers	1·3	·5	...	1·8
Between last point and 1st phalangeal joint	1·0	·45	...	1·45
1st phalangeal joint	·85	·425	...	1·275
Middle of 2nd phalanx	·8	·4	...	1·2
2nd phalangeal joint	·4	·4	...	·8
A little below nail	·4	·325	...	·725
Sum	4·75	2·5	...	7·25
Mean	·791	·416	...	1·208
21.—*Radial side.*				
Midway between cleft of fingers and 1st phalangeal joint	1·1	·5	...	1·6
1st phalangeal joint	·85	·4	...	1·25
Middle of 2nd phalanx	·8	·325	...	1·125
2nd phalangeal joint	·6	·25	...	·85
Middle of last phalanx	·425	·225	...	·65
Sum	3·775	1·7	...	5·475
Mean	·755	·340	...	1·095
22.—*Ulnar side* (forming inner margin of hand).				
Point corresponding to base of 5th metacarpal bone at side of hand	1·1	·8	1·1	2·2
,, ,, middle of ditto	1·0	·7	1 0	2·0
,, ,, 5th metacarpo-phalangeal joint	·8	·5	...	1·3
,, ,, crease opposite cleft of fingers	·75	·375	...	1·125
Between last and 1st phalangeal joint	·75	·35	...	1·1
1st phalangeal joint	·7	·3	...	1·0
Middle of 2nd phalanx	·6	·25	...	·85
2nd phalangeal joint	·5	·225	..	·725
Middle of last phalanx	·45	·2	...	·65
Sum	6 65	...	4·30	10·95
Mean	·738	...	·477	1·216

DESCRIPTION OF PLATES IV AND V.

These plates (reduced from photographs) show the precise spots at which measurements of the sensibility of the hand were taken. The two lines forming each cross indicate the two directions of measurement. The number written against each cross is the sum of the two measurements.

Fig. 1.—Palmar surface of hand and fingers.
„ 2.—Dorsal „ „
„ 3.—Radial side of hand and fingers.
„ 4.—Ulnar „ „

Fig 1

Fig 2

G H Ford

W West imp

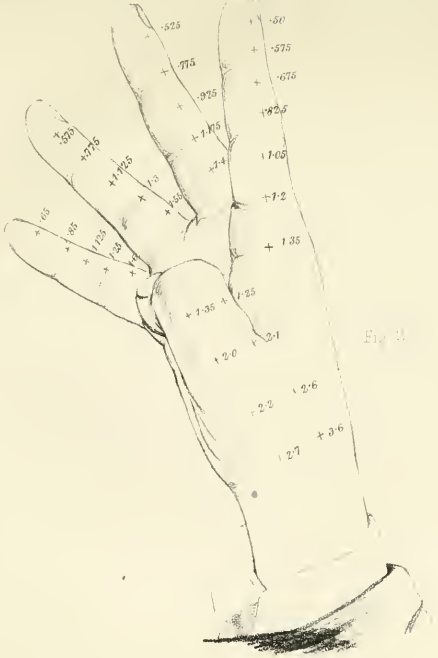
·525
·775
·925
1·175
1·4
1·525
1·75
·525
·775
1·175
1·3
1·35
·65
·85
1·25
1·35
·50
·575
·675
1·825
1·05
1·2
1·35
1·25
2·1
2·0
2·6
2·2
3·6
2·7

Fig 3

·65
·90
1·15
1·4
1·6
·65
·725
·925
1·175
1·35
·95
·90
1·05
1·4
1·6
·65
·725
·85
1·0
1·1
1·125
3·7
2·7
3·6
1·3
2·0
4·0
4·1
2·3
5·0
4·8

Fig 4

ON THE INFLUENCE

OF

PARALYSIS, DISEASE OF THE JOINTS, DISEASE OF THE EPIPHYSIAL LINES, EXCISION OF THE KNEE, RICKETS,

AND SOME OTHER MORBID CONDITIONS,

UPON THE

GROWTH OF THE BONES.

BY

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The following paper is intended as a continuation of, or as supplementary to, a paper by the author, published in the last volume of the Society's 'Transactions.'

Case 1.—A man, æt. 58, paralytic on the right side, more or less, since he was three years old; almost completely since he was nine or ten.

Length of right humerus, 12 inches; of left, 13 inches.					
„	radius	$9\frac{1}{4}$	„	„ 10	„
„	femur	15	„	„ $16\frac{1}{2}$	„
„	tibia	13	„	„ $14\frac{1}{4}$	„

The fingers and thumb on the right side rather short. No difference between the clavicles. Right foot in a state

of talipes equinus, with the heel drawn up and the toes curved backwards, so that it is difficult to compare the length of the two feet.

Case 2.—A man, æt. 17, lost the use of the right lower limb, after smallpox, when six months old. The limb dangles useless, cold, and shrivelled.

Length of right femur, 13 inches; of left, 15 inches.						
„	tibia	12	„	„	13½	„
„	foot	8	„	„	9	„

Case 3.—A girl, æt. 6. Right lower limb palsied and withered from infancy, with tendency to valgus in foot.

Length of right femur, 9 inches; of left, 10 inches.						
„	tibia	7	„	„	7·6	„
„	foot	5	„	„	5·3	„

Case 4.—A man, æt. 39. Right lower limb paralysed from infancy. Always walked with wooden leg, bearing upon it with his knee. Foot and leg shrunken, and quite useless. The foot bent up, and small.

Length of right femur, 16·5 inches; of left, 19 inches.						
„	tibia	13·2	„	„	16	„

Case 5.—A man, æt. 44. Paralysed on right side in infancy. Soon recovered the use of the right upper limb, but not of the lower limb. Can move the thigh, the leg, and the toes a little, the foot not at all. The foot, in a state of talipes equinus, appears nearly as large as the other.

Length of right femur, 16 inches; of left, 17 inches.						
„	leg	12	„	„	14	„

Case 6.—A girl, æt. 6. Left lower limb palsied from infancy. Foot rather small, in state of talipes equinus.

Length of left femur, 9·2 inches; of right, 10·3 inches.						
„	tibia	7·4	„	„	8·4	„

Case 7.—A girl, æt. 12. Right lower limb palsied and

atrophied from infancy, with talipes equinus, and slight inversion of foot; has very little motor power over leg, foot, or toes; can scarcely extend the foot or leg at all, but can move the thigh more freely on the pelvis. Little or no difference between the two feet in size.

Length of right femur, $12\frac{1}{2}$ inches; of left, $13\frac{1}{4}$ inches.
„ tibia 10 „ „ 11 „

Case 8.—A woman, æt. 70. Right upper limb palsied from infancy. She had been told that it was natural at birth, but was injured at the shoulder when she was six months old. The only movement in the limb that she can effect is slight flexion and extension of the first phalanx of the thumb upon the metacarpal bone. Nevertheless the length of the several bones is the same as in the opposite limb, with the exception of the humerus, which is three inches short (8 inches to 11). This bone hangs loosely from the scapula; and the line of junction of the upper epiphysis with the shaft can be felt to be remarkably prominent and tuberculated.

The marked shortness of the humerus, while the other bones of the limb have acquired their proper length, added to its knottiness near the upper end, gives probability to the woman's account of the cause of her loss of use of the limb. This is, however, not certain; and as the limb has been paralysed from infancy I place the case under this head, though it might perhaps have been classed with the cases of impairment of growth from injury and disease of the epiphysial lines.

The thinness of the bones in paralysis, in other words, the deficiency of lateral growth, is a more marked and constant feature, and affords a better example of the relation between the growth of the bones and muscular action, than the deficiency of length. Indeed, in some cases of paralysis, the limb attains to the same length as the opposite member; and the preceding cases show that the deficiency of longitudinal growth is very irregular. Usually, however, it is apparent throughout the affected limb, and is, on the whole, most marked in parts where the paralysis is most complete.

Thus, in the instance of the lower limb, the shortness is not usually most distinct in the thigh—that is, in the segment where growth naturally proceeds at the greatest rate, and where, consequently, the deficiency might have been expected to be most apparent—but in the leg; and the paralysis in the thigh is commonly less complete than in the leg. The proximate cause of the want of growth is not to be sought in that tonic condition of the muscles which often follows paralysis, and which causes the talipes of the foot; for, in valgus, where a similar tonic condition exists, the leg attains its proper length.

Impairment of Growth from disease of Joint.

Case 9.—Man, æt. 30. Left hip dislocated and ankylosed from disease, when he was ten years old. Left femur half an inch shorter than the right. The tibiæ and the feet of equal length in the two limbs.

Case 10.—Lad, æt. 16. Disease of hip for six years, causing inability to use the limb, so that he bore upon crutches and the other limb. The femur three quarters of an inch, the tibia half an inch, and the foot one inch short. The shortness of the foot is partly due to its being preternaturally bent.

Case 11.—Man, æt. 41. Right hip ankylosed from disease, when he was ten years old.

Length of right femur,	14	inches;	of left,	17	inches.
„ tibia	12	„	„	13·2	„
„ foot	8·5	„	„	9	„

Case 12.—Man, æt. 40. Right hip ankylosed from disease, when he was nine years old.

Length of right femur,	17	inches;	of left,	18·5	inches.
„ tibia	13	„	„	14	„
„ foot	9	„	„	10	„

Case 13.—Girl, æt. 11. Lame from affection of left hip for three years, and come into the hospital on account of an aggravation of the disease.

Length of left femur,	12·5	inches;	of right,	13·5	inches.	
„	tibia	10·3	„	„	10·5	„

I may mention, as a point of some practical importance, that the difference in the measurement of the two limbs from the spines of the iliac bones to the malleoli, in this case, gave rise, at first, to the supposition that dislocation had taken place at the hip.

Case 14. — Lad, æt. 14, with long-standing disease of knee, and with deep cicatrices over the articular ends of the bones, especially over the tibia. The joint bent nearly to a right angle, and very slight movement practicable. The femur and the tibia were each an inch and a quarter shorter than in the opposite limb.

Case 15.—Man, æt. 51. Had disease of left knee, caused by a sprain, when ten years old. It gathered and burst, leaving impaired movement of joint, thickening of the lower part of the femur, and deep cicatrices above the knee. The limb two inches shorter than the other, the difference being chiefly in the thigh. The feet of equal size.

Case 16.—Girl, æt. 17. Disease of left knee, of eleven years' duration, rendering the limb useless.

Length of left femur,	16·2	inches;	of right,	17	inches.	
„	tibia	12	„	„	13·2	„
„	foot	7·2	„	„	8·5	„

In this class of cases, as well as in the paralytics, the deficiency of growth is usually apparent in all the segments of the affected limb, though it is most marked in those contiguous to the diseased joint. It depends doubtless, as in paralysis, in great measure, upon imperfect use of the limb; and this is, commonly, most marked in the segments conti-

gnous to the diseased joint. In some instances (as in Case 15), the growth is rendered more defective by the disease extending through the epiphyses to the shafts, and so involving the epiphysial lines.

One might infer that in some of these cases the side of the pelvis must share the deficiency of growth with the affected lower limb; and the inference is strengthened by a case published by Dr. Barnes,[1] in which the left side of pelvis, measured, externally, from the sacrum to the symphysis, was an inch and a half smaller than the right, the patient having been lame in the left leg, which was an inch short, from the age of two years, when the ankle was broken. I have not, however, had an opportunity of verifying this supposition by measurement, and I am not aware that females with shortness of one lower limb, from ankylosed joint or other disease, are peculiarly liable to difficulty in parturition.

The following Case (No. 17.) presents a remarkable condition of the lower jaw associated with immobility.

Alexander Pedley, æt. 5, healthy and well-nourished, was brought to the hospital in July, 1845, on account of the lower jaw being fixed, with the mouth closed. I could find no disease in the jaw, or its joint, or the surrounding soft parts, to account for the immobility of the bone. The upper incisors were broken off; and the lad fed himself through the vacancy thus caused, crumbling the food with his fingers against the lower incisors. His mother said that he could open his month very well till two and a half years previously, when abscesses formed and burst near the left angle of the jaw. Since that time the month had remained closed. Various means were tried to restore movement, without success.

He came to Cambridge again, April 5, 1862, and I had the accompanying profile photograph and drawing taken (Plate VI, Fig. 1). He is twenty-one, of boyish appearance, and five feet four inches high. The size of his head and upper part

[1] 'Obstetrical Transactions,' for 1861, p. 315.

of the face is about in proportion to his stature. The cheeks, lips, and opening of the mouth are at least so. The lower jaw is almost completely fixed, with the molar teeth clenched against the upper ones, so that there is no perceptible interval between them; still, when he makes an effort to open and close the mouth, the masseter and other muscles contract, and the teeth slide a very little upon one another. The lower jaw is as broad as natural at the angles; and the angular parts have descended nearly to their proper level; but the arch formed between the two angles is extremely short. Indeed the body and the mental portions of the jaw run forward scarcely at all, and do little more than pass across from one angle to the other. The chink (*a*) corresponds with the line of this part of the jaw. The chin is in a plane two inches behind the anterior alveolar edge of the upper jaw, instead of being a little in front of it. There has been, therefore, a failure, amounting to at least two inches, in the growth of the body of the jaw in length; and it is also less deep than natural. The failure, however, has not been shared in quite an equal degree by the alveolar portion. This forms a segment of a larger circle, taking a wider sweep, and, consequently, overhanging the lower part of the body of the jaw (Plate VI, Fig. 2). By this means greater room is given for the teeth, which are as numerous and as large as natural; and they are disposed in a slanting, or fan-like manner, so as to bring the crowns of the molars and hinder bicuspids into contact with those of the upper jaw. The front bicuspids and the incisors are, however, still a good deal behind the upper ones. The hyoid bone is small, and is lower than it ought to be; it is in the position marked *b* (Fig. 1). The interval between it and the chin (*a*) is occupied by the tongue. The larynx is also small; and his breathing is difficult and noisy when he runs or works. He can only run a short distance in consequence of the difficulty of breathing; and his snoring when he sleeps is a source of great annoyance to others.

In this case, and in some others of a similar kind which have been described, the fixity of the jaw is not quite explained. Its effect, however, upon the growth of the bone has been very marked. It is interesting to observe that the size of the teeth has not been influenced, although they have, throughout life, been useless. Moreover, the ramus, or vertical part, of the bone, which is much dependent on the teeth for its length, and the alveolar part, which is dependent on them for its existence and growth, have not failed so much as the basal part of the bone. The want of the uniformity in proportion between the alveolar and the other parts of the jaws, consequent on the size of the one being related to the teeth, and that of the other parts being, in great measure, dependent upon other causes, which is so well exemplified in this case, is seen also in the idiot; and the resemblance of the profile of this patient's face to that of the idiot will have attracted attention. It is the same want of uniformity, causing variety in the degree of projection of the alveoli, which gives rise to the most characteristic differences in features between the several members of the human family, and forms the basis of one of the most generally received modes of classification.

Mr. Hulke referred me to a case in many respects similar in the 'Archiv für clinische Chirurgie,' i, 450. Langenbeck, who relates the case, first divided the masseter muscles without any effect, and, subsequently, arriving at the conclusion that the inability to open the mouth was caused by the coronoid processes having become locked against the zygomatic arches, he cut through those processes, and by this means set the jaw free. He also quotes two similar cases from Vrolik's 'Tabulæ,' and in one of these, of which he gives a drawing, there is a remarkable obliquity of the coronoid process. I was induced by this to attempt the same operation in my patient in February last, but could not succeed in consequence of there being no discoverable interval between the coronoid and condyloid processes beneath the zygoma. I accordingly cut through the ascending ramus of the jaw on each side, and, subsequently, prevented

osseous reunion by moving the chin up and down. This was followed by great relief. The wounds healed quickly. He left the hospital in April, with directions to continue the movements of the jaw. In July he could open the mouth about an inch, could breathe better, and did not make nearly so much noise in his sleep.

Impairment of growth from the Cicatrix following a Burn.

Case 18.—A man, æt. 53, burnt in childhood. Cicatrix covering the lower part of forearm, retracting the thumb and holding the fingers bent. The forearm two inches short; the fingers and thumb nearly, if not quite, of their proper length.

The stinting of the growth, in this case, was probably attributable to the resistance offered by the cicatrix to the lengthening of the bones of the forearm. In other words, the pressure exerted by the cicatrix was greater than the force of growth at the epiphysial lines could overcome.

Impairment of growth from disease in the Epiphysial lines.[1]

Case 19.—A boy, æt. 3, was injured at the upper epiphysial line of the right humerus, by his father lifting him up to kiss him. Suppuration slowly followed. The abscess burst and healed spontaneously in about a year, leaving a deeply indented cicatrix. The movements of the joint were recovered, and the lad had free use of the limb; but the humerus was an inch shorter than the other. He is now nine years old; and the difference in length between the two arms is still an inch, showing that, though the growth was impeded during the progress of the disease, it has proceeded as well as in the opposite limb since the part healed.

Case 20.—A man, æt. 43. Disease involving the lower end of the right femur and the upper end of the tibia, whenhe was six years old, which left impaired movement of the joint,

[1] See also Case 8, p. 285.

and deep cicatrices over the lower part of the femur. The right thigh was broken when he was sixteen, and the right leg was broken when he was twenty-nine. Both fractures had united without any displacement.

Length of right femur,	13	inches;	of left,	19	inches.
„ tibia	12·3	„	„	14·2	„
„ foot	10·8	„	„	10·2	„

Case 21.—A lad, æt. 15. In infancy had disease at lower part of right thigh, with gathering and discharge of bone, caused by an injury. Indented cicatrices above the knee. Limited movement of the knee-joint. The right femur measures ten and a half inches; the left femur fourteen inches. The tibiæ are of equal length, eleven and a half inches. There is also no difference in size between the feet.

Case 22.—A man, æt. 50. When twelve years old had disease of upper part of right tibia, involving the epiphysial line, causing exfoliation of bone, and leaving deep scars with thickening of the head of the bone, and some impairment of the movement of the knee-joint. No decided difference in length between the feet; but the right foot in the state of talipes equinus.

Length of right femur,	15	inches;	of left,	16	inches.
„ tibia	11	„	„	13	„

Case 23.—A woman, æt. 50. Had disease near lower end of right tibia, after smallpox, when ten years old, leaving scars connected with the bone a little above the ankle. The tibia is slightly thickened and knotty at the part, and it is three quarters of an inch shorter than the other tibia.

An interesting feature is furnished in this case, by the fact that the fibula has not shared in the imperfection of growth with the tibia, but is as long as the corresponding bone of the other leg. Accordingly the outer malleolus has descended considerably below its proper position in relation to the other bones of the ankle, and nearly touches the

ground. To permit this there must have been a proportionate elongation of the ligaments binding the malleolus to the tibia and the tarsal bones.

Another instance of the like kind—a displacement of the upper end of the fibula under similar circumstances—is presented in the following case.

Case 24.—A healthy robust girl, æt. 15, (Plate VII, Fig. 1) with curvature backwards in the right tibia, near the juncture of the shaft with the upper end of the bone. It causes the tuber tibiæ to be in a hollow and scarcely discoverable, instead of standing out in strong relief as in the other leg. It causes also the leg to form an angle backwards, of about 120° with the thigh, when the knee is fully extended. There is no other apparent defect in the limb, no pain, and not much lameness. She says that the altered shape of the limb is of recent occurrence; that six months ago the limb was as straight as the other, and that, gradually, without any apparent cause, it has become bent. On first examination, I thought there must be some defect in the crucial ligaments, permitting the joint to be extended beyond the straight line. But more careful examinations showed the knee to be sound, and the leg-bone only at fault.

The above note was made in May, 1858. The girl was kept in bed, and mechanical means were perseveringly employed to effect some improvement, but without much benefit. However, the deformity did not increase; for in September, 1861, the limb presented much the same appearance as it had done in 1858. A careful examination leads me to the same conclusion, viz., that there is a bend backwards in the upper end of the tibia. I find the tibia an inch shorter than the other tibia; but the fibula has maintained its proper length, and the head of the fibula has risen above the level of the head of the tibia, the ligaments connecting the two bones having yielded. This is further shown by the fact that the displaced head of the fibula can be moved backwards and forwards, whereas the corresponding part of the other fibula is quite fixed.

The knee-joint does not admit of complete extension; and a position short of complete extension is sufficient to bring the leg into a line with the thigh owing to the bend in the tibia.

This case seems to be explainedby the supposition, that, for some reason, the growth in the fore part of the upper epiphysial line has not kept pace with that in the hinder part, and that the articular surface of the tibia has, in consequence, become inclined forwards.

Case 25.—A woman, æt. 59. A deep cicatrix over the distal end of the middle metacarpal bone from disease, when she was ten months old. Movements of joint unimpaired. The bone an inch shorter than the other metacarpals. The phalanges of proper length.

I may remark that disease in the epiphysial lines of the long bones, acute as well as chronic, is more frequent than is usually supposed, and is deserving of more attention than it has hitherto received. This is particularly the case with the lower epiphysial line of the femur.

Shortening does not always follow. I have seen cases of severe disease in the epiphysial lines, attended with suppuration and discharge of bone, which have recovered, and in which the limbs have maintained their proper length.

Imperfection of growth, when it occurs, is not always confined to the diseased bone; but, as in the cases of diseased joint, it may be manifested in other parts of the limb. This is not, however, usually observable to any great extent, probably because after the disease has subsided the movements of the limb are not so much impaired as when a joint has been the seat of suppuration.[1]

[1] Mr. Stanley, 'Diseases of the Bones,' p. 9, mentions the case of a child in whom there was an abscess upon the upper part of the tibia, accompanied by a partial separation of the epiphysis. It was followed by so slow a growth of the tibia, that, several years afterwards, the bone was 1½ inch shorter than the tibia of the opposite limb.

Imperfect growth from defect in development.

Case 26.—A woman, æt. 40. Defective development of right hand. Thumb of about natural length, but phalangeal joint wanting, all the phalanges of fingers wanting. The metacarpal bone of forefinger with well-formed head and of proper length. The three other metacarpals terminate in pointed ends, their epiphyses not being, apparently, developed, and each has failed to attain its proper length by an inch. Right radius measures 9·3 inches; left radius 9·8. Right humerus measures 12·3 inches; left humerus 12·8.

The shortness of the arm and forearm is probably due to want of proper use of the limb. The shortness of the three metacarpals is probably due to the want of the epiphysial apparatus for growth.

Case 27.—The drawing (Plate VII, Fig. 2) represents the left ulna, radius, and lower end of the humerus taken from a middle-aged man in the dissecting-room. The ulna is only five inches in its entire length. Its lower end is tapering, without any enlargement or trace of an epiphysis, and it was connected with the lower end of the radius by thick bands of fibrous tissue.

The absence of the epiphysis in this case may be fairly assumed to be the cause of the shortness of the shaft.

I would, in passing, call attention to the deformity at the elbow which this specimen shows.

The capitulum of the humerus is small, and not covered by cartilage; and the head of the radius rests not upon it, but lies an inch and a quarter above it, upon the fore part of the ridge that ascends from the outer condyle to the shaft. The head of the radius is deformed, flattened upon the inner side, where it is applied upon the ridge, and tuberculated. The trochlea of the humerus is imperfect, the greater sigmoid cavity of the ulna is misshapen, and the lesser sigmoid cavity is applied against a projecting portion of the lower end of the humerus. The radius is preternaturally curved and measures seven inches and a half.

In the right arm (Plate VII, Fig. 3) there is a similar position of the head of the radius, and a similar condition of the capitulum of the humerus. The ulna is firmly ankylosed to the humerus: it measures eight inches: its lower end is well formed, and is on the proper level with the lower end of the radius. The latter bone measures eight inches. The shortness of the ulna in this limb is probably dependent upon the ankylosis of its upper end.

In neither limb is there any preternatural elongation of the neck of the radius; for, in each, the tubercle bears its usual relation to the head of the bone, and has ascended like it, so as to be above the level of the condyle of the humerus. It seems pretty clear that the ascent of both tubercle and head of the radius has been caused by a want of proper relation between the growth of the two bones of the forearm. The ulna was stunted while the radius continued to grow. It is probable, also, that the capitulum of the humerus was, in each limb, originally defective, so that the natural check to the ascent of the radius was wanting.

Examples of ascent of the head of the radius above its proper level in front of the outer condyle, or more commonly behind it, have been given by others under the title of "congenital dislocation of the radius."[1] The description of these shows a correspondence with the above case in the want of proper relation, as to length, between the radius and the ulna; for in each instance I find that the lower end of the radius descended as low as that of the ulna, although the upper end ascended to a level with the top of the olecranon. No evidence, however, is furnished in any of the cases that the ulna was in fault. Indeed, no mention is made of the length of the ulna. Both Cruveil-

[1] Sandifort, 'Museum Anatomicum,' tab. ciii, figs. 1, 2, 3, and 4, 5, 6; two cases. Dupuytren, 'Journal Hebdomadaire de Médecine,' vii, 45, both arms of same patient. Cruveilhier, 'Anatomie Pathologique,' 9me livraison, Pl. iii, figs. 4, 5, 6, and Pl. iv, fig. 4; two cases. That the displacement was not the result of accident in these cases, is proved by the fact that, in each, the carpal ends of the two bones of the forearm reached to the same level. R. Adams, 'Cyclopædia of Anatomy,' ii, 75.

hier and Adams speak of the neck of the radius being elongated, and attribute the ascent of the head of the radius to the elongation of the neck. But this view is opposed to the fact, mentioned by each author, that the tubercle of the radius was on a level with the coronoid process and lesser sigmoid cavity of the ulna. It is clear, therefore, that the tubercle had ascended as much as the head; and the change of position in both must have depended upon, or been associated with, a growth in the lower part of the radius disproportionate to that which took place in the ulna.

Case 28.—A healthy girl, æt. 10. Deformity of left forearm (Plate VII, Fig. 4) from the ulna not descending to its proper level. Its lower end may be felt nearly an inch above the lower end of the radius. The articular surface of the radius is inclined a little towards the ulna, and the shaft of the radius is preternaturally arched; hence the hand slants towards the ulnar side. The flexor and extensor tendons may be felt in the interval between the lower end of the ulna and the carpus. The movements of the hand and forearm are free, but the member is weak. Does not know how long the deformity has existed, but attention was directed to it last harvest, in consequence of her being unable to gather up the wheat, in gleaning, quickly and well.

The measurements are given, which were taken at two periods:

	May, 1860.	March, 1862.
Length of left radius	6·5 inches	7·2 inches.
„ „ ulna	5·5 „	5·6 „
„ right radius	7· „	7·9 „
„ „ ulna	7·5 „	8·4 „
„ left hand	5·3 „	6· „
„ right „	5·3 „	6· „
„ left humerus	9·5 „	10·7 „
„ right „	9·5 „	10·7 „

The slight deficiency in the growth of the radius is probably due to the greater deficiency in that of the ulna. Indeed, the ulna has scarcely increased at all during the

two years. There is no evidence of disease, but the lower end of the ulna is small; and growth appears to have stopped there.

I have given these three cases at some length, because I am not aware that the absence or imperfect development of epiphyses and the consequent failure of growth have previously attracted the attention of pathologists. Case 25 is clearly an example of this kind, there being no trace of the epiphysis of the left ulna. There is every appearance that Case 24 is so too. Case 26 is more uncertain. Possibly it is an instance of absence or premature ossification of the line between the epiphysis and the shaft. If this be so, it would correspond with the cases of *pelvis oblique ovata*, in which the transverse growth of one side of the pelvis is impeded by absence or early obliteration of the sacro-iliac synchondrosis. The examples of narrowness and other deformities of the cranial vault, from absence of the parietal and other sutures,[1] and those of shortness of the base of the skull, from coalescence of the sphenoid and occipital bones,[2] are of the same kind.

Congenital deficiency of size.

The following cases are examples of simple congenital deficiency of size, in the limbs and in the lower jaw.

Case 29.—A man, æt. 44. Right lower limb smaller in every part than the left. The thigh one and a half inch short; the leg half an inch. The foot also small. The right side of the pelvis measures one inch less than the left. The right calf is three inches, and the thigh two inches less in circumference than its fellow. He says the limb is as strong as the other, and that he will "walk twenty miles with any man." The smallness of the limb was observed immediately after his birth, the right heel not reaching to the level of the

[1] See my 'Treatise on the Human Skeleton,' p. 244.

[2] Virchow, 'Entwickelung des Schädelgrundes,' taf. iv; and 'Abhandlungen zur wissenschaftlichen Medicin,' s. 899.

left ankle. He is of moderate stature, and in other respects well made.[1]

Case 30.—A little girl was observed to be rather lame—to waddle—as soon as she began to walk. I saw her when she was a year and a half, when she was four years, and when she was six years old. The left lower limb was on each occasion an inch short. There was no tilting of the pelvis or impairment of movement in any of the joints; but careful measurement showed the left femur to be an inch shorter than the right. The difference between the two thighs was no greater on the last time of my seeing her than on the first.

Case 31.—A female infant, æt. 17 weeks. Deficiency of length in the body of the lower jaw, so that the chin is considerably behind the level of the upper jaw, and the upper lip is in a plane nearly an inch in front of the lower lip. Movements of the jaw free, and no other fault in the construction of the parts. The tongue, fauces, and palate well formed; but there is difficulty in swallowing and breathing, inspiration being often attended with a peculiar croaking noise. This appears to depend upon there not being sufficient space for the tongue within the small arch of the jaw. When the child was two years old, the deficiency in size was as marked as ever, but the jaw had grown, and, apparently, in proportion to the other bones of the face. The difficulty in swallowing and breathing remained. The child was weak, but as quick and sensible as other children of her age.

[1] This may be classed with an example of congenital inequality of the two sides of the body, including the limbs, thorax, and skull, given in Brown-Séquard's 'Journal de Physiologie,' Jan., 1859, p. 70, and with the skeleton in the museum at Bonn, in which the limbs are of unequal length. The measurements are given in my 'Treatise on the Human Skeleton,' p. 54. Examples of congenital inequality of length in the corresponding limbs, or of shortness of one or more segments in one or both limbs, are not uncommon, but the deficiency is usually associated with some other malformation.

In each of these cases, though the part was congenitally small, yet its growth subsequent to birth appears to have been proportionate to that of the rest of the body.

Increase of growth.

The following is the only instance of increase of growth from disease that I have met with.

Case 32.—A youth, æt. 17. A sinus on the inner side of the left thigh, three inches above the knee, extending down to the shaft of the femur. Thickening about the bone and fulness of surrounding structures. Portions of bone have come away. Disease of more than two years' duration. The limb struck me as being longer than the other. The spine of the ilium of this side is higher than on the other side, and the foot descends lower than the right foot. Careful measurement proves the left femur to be an inch longer than the right. The upper limbs and the other segments of the lower limbs are of equal length on the two sides.

We must suppose that the disease in the lower part of the shaft of the femur acted as a stimulus to preternatural activity of the growing processes in the epiphysial line; at least I know of no other explanation of the preternatural elongation of this femur. And if this be the explanation, it is remarkable that the same thing does not more often occur, especially in the tibia and humerus, considering the frequency of prolonged disease of the shafts of those bones in young persons. I have been on the watch for some years, and have made many measurements, but have not yet found another instance of the kind.[1]

[1] Mr. Stanley and Mr. Paget have seen instances of elongation of the femur similar to the one described above. Paget's 'Surgical Pathology,' i, 83. The elongation and curvature of the tibia from chronic inflammation of the shaft, described in this work (p. 85), deserve further investigation. I have not met with any distinct example of *elongation* of one

The Effect of excision of the Knee upon the growth of the limb.

The question of the growth of a limb after excision of the knee, is one of much importance with reference to the propriety of performing the operation in young subjects; and sufficient cases have now occurred, in which time enough has elapsed, to enable us to arrive at some definite conclusions.

The following table contains a list of all the cases respecting which I have been able to obtain data bearing upon the question.

They amount to eighteen. In the first eight on the list the growth of the limb operated on has maintained its proper rate as compared with that of the other limb. It will be observed, however, that the operation was, in two of these, performed at the age of seventeen, and at this period the growth of the body may have been nearly completed.

In all these eight cases a small amount only of the bones was sawn away, probably in none of them was either of the epiphysial lines interfered with, except in No. 8. In that

bone in a limb taking place as a *compensation* for a deficiency in another bone. Indeed, in all the cases I have seen, in which deficiency in the length of one bone, from whatever cause induced, has been attended with any deviation from the natural standard of length in the other bones, that deviation has consisted in a *falling short* of the proper size.

A case of elongation of the limb in aneurismal varix, and attributed to the retardation of the venous blood, is given in M. Broca's 'Des Anévrismes,' 1856, p. 76. Fourteen years previously, when the man was young, the crural artery and vein were wounded a little below Poupart's ligament. Aneurismal varix resulted, and the growth of the limb was increased beyond that of its fellow three centimeters. One third of this elongation was in the femur, two thirds in the tibia. The foot was also about half a centimeter too long. The patient limped (*boitait*) a little, but supposed that to result from feebleness of the limb, not suspecting that it proceeded from inequality in length. M. Broca says that preternatural growth of the hair on a limb is not unfrequently observable under similar circumstances. Certainly an increase of growth is not a result that one would expect from an impeded circulation of the blood in a part.

instance it is stated that two inches and a half were removed from both the bones. The patient, however, was seventeen years old at the time of the operation; and we must not draw much inference from the report of the limb keeping pace with its fellow after that age.

In the remaining ten cases the growth of the limb was more or less arrested. In six of these (9 to 14 inclusive) considerable quantities of the bones were removed. The epiphysial lines were probably interfered with, or cut away, in all.

Thus far we have a corroboration of the opinion, based upon physiological grounds, that the prospect of growth in the limb subsequent to the operation, has relation to the amount of bone removed; that, if the epiphysial lines be left intact, the lengthening of the limb will probably keep pace with that of its fellow; but that, if the epiphysial lines be cut away, the growth of the limb is pretty sure to be stinted.[1]

It has been objected to this view that the interference with growth after excision is not confined to the bones which have been operated on, and which may have been deprived of their epiphysial lines, but is evidenced in other parts of the limb, commonly in the fibula, and sometimes in the foot. The facts are undoubtedly as represented. Nos. 10, 13, 16, and 17 in the table, prove that the foot participates in the deficiency of growth after excision, and there is little question of the fibula doing the same. But the cases which have been given in the preceding part of this paper show that this is precisely what might have been expected, and that the objection grounded upon these facts is not a valid one. Those cases prove that a cause which operates prejudicially upon the growth of any one part of a limb, say by ankylosing a joint or damaging an epiphysial line, usually exerts a similar influence, more or less, upon the other parts of the limb; so that a failure of growth in the foot, and in the several parts of the leg, is quite to be expected as a sequence

[1] This opinion was advanced by me in a paper on excision of the knee in the 'Medico-Chirurgical Transactions,' vol. xli, p. 216.

of the destruction of an epiphysial line, either in the tibia or the femur, and still more in both.

In the last three cases on the list the limbs operated on have failed to keep pace with their fellows, although the portions of bone removed were not large (one inch of femur and three quarters of an inch of tibia, in a girl, aged fifteen, in No. 16; articulating end of femur and half an inch of tibia, in a boy, aged twelve, in No. 17; and about three quarters of an inch of femur and one quarter of an inch of tibia, in a girl, aged three, in No. 18). Admitted that the epiphysial lines, or some of them, were spared in these cases, they show that the precaution of leaving those parts intact will not always ensure the perfect future growth of the limb. Other circumstances may interfere with it, such as the injury done to the limb by the operation, and the necessary after treatment, or by the disease which rendered the operation necessary. It may also happen that during the suppurative and other processes following the operation, the epiphysial lines may become involved, and more or less disorganized; and the growing powers of the limb may be in this way impaired.

It should be observed that in nearly all the cases in which the growth has been impaired, even in those in which it has been so to the greatest extent, the reports state that the limbs are exceedingly useful. Indeed it would seem that the efficiency of the limb in each case is not materially lessened by its shortness.

I think we are justified in concluding—*First*, that if the epiphysial lines are sawn away in the operation of excision of the knee, the subsequent growth of the limb will be impaired; *secondly*, that if the epiphysial lines be left intact, there is much probability that the growth of the limb will fully or nearly equal that of the other limb; *thirdly*, that the probability, or even the certainty, of a failure of growth in the limb is not to be regarded as a fatal objection to the operation, and scarcely constitutes an objection at all after the age of fourteen or fifteen.

TABLE I.—*Measurements after Excision of Knee, showing the*

No.	Name of operator.	Sex and age of patient.	Date of operation.	Date of measurement.	Amount of bone removed.	From iliac spine to internal malleolus.		Of femur.	
						Operated limb.	Opposite limb.	Operated limb.	Opposite limb.
1	Page	Girl, æt. 12	Oct., 1856	Sept., 1861	1 inch of femur; thin slice of tibia	22·3	23·5	11·5	12·5
2	Brother-stone	Boy, æt. 10	May, 1854	Feb., 1861	$\frac{3}{4}$ths inch of femur; $\frac{1}{3}$rd inch of tibia.	The operated limb has grown			
3	Ditto	Boy, æt. 11	Jan., 1855	Feb., 1861	$1\frac{1}{2}$ inch from both	Both limbs grown two inches $1\frac{2}{3}$rds inch shorter than the			
4	Humphry	Boy, æt. 12	Aug., 1855	Sept., 1861	Thin slice from each bone	...	...	14·5	15·5
5	Ditto	Girl, æt. 12	July, 1858	Sept., 1861	Thin slice from each bone	...	...	13	14
6	Ditto	Boy, æt. 16	Aug., 1858	April, 1862	The cartilaginous surfaces only	$32\frac{3}{4}$	$33\frac{3}{4}$	...	...
7	Sympson	Girl, æt. 17	April, 1858	Aug., 1861	Trochlear surface of femur and thin slice of condyles; other portions gouged out. Tibia not touched	Length of limb ($1\frac{1}{2}$ inch short), limb, the same as soon after			
8	Page	Lad, æt. 17	June, 1852	Sept., 1861	$2\frac{1}{2}$ inches of femur and tibia	"The two limbs have so well till the close of his growth walks along, to be of nearly in the one being made up by			
9	Keith	Boy, æt. 9	Nov., 1853	1859	2 inches of both bones	Operated limb 7 inches short			
10	Pemberton	Boy, æt. 12	Feb., 1854	1859	$3\frac{1}{2}$ inches of femur and tibia	Operated limb 9 inches short			
11	H. Smith	Boy, æt. 6	Oct., 1854	Jan., 1861	Good 2 inches (abscess in head of tibia, necrosis in intercondyloid space)	Operated limb between 4 and			
12	Jones, of Jersey	Girl, æt. 9	Aug., 1855	March, 1862	Large portion of joint-ends removed; likewise the head of fibula	...	...	$12\frac{1}{2}$	$15\frac{1}{2}$

amount of growth of the limb as compared with the other limb.

Of tibia.		Of foot.		Present condition of limb.
Operated limb.	Opposite limb.	Operated limb.	Opposite limb.	
10·7	11	9·2	9·2	"Girl walks well, without either crutch or stick. Is short for her age. There can be no doubt that the growth of the two limbs has been equal."—*Med. Times and Gaz.*, Feb. 16th, 1861.
in proportion to the other				Anchylosis.
every year; operated limb				Ditto.
12 5	13	Equal		Anchylosed, and well able to bear weight of body, but rather too much bent.
10·6	11·3	Equal		Quite firm and able to bear weight, but too much bent. Measurements in three successive years showed growth in thigh and leg-bones of two sides to be equal.
...	...	...		Firmly anchylosed so that he can walk well. Has grown two inches since the operation.
as compared with the other				"Bones anchylosed; patient walks about with thick sole."—*Brit. Med. Journal*, Aug. 17th, 1861.
the operation				
kept pace with each other				
that they now appear, as he				
equal length, the deficiency				
his walking upon his toes."				
after six years				"With the aid of a boot propped up by steel rods, he walks and runs with great ease and energy."—*Brit. Med. Journal*, 1859, p. 960.
after six years. Foot, 1½ short				"Bones connected by moveable fibrous medium. Still limb can bear the whole weight of body, and with aid of cork sole he works hard as a boat-builder."—*Brit. Med. Journal*, 1859, p. 960.
5 inches short				"Limb very useful."—*Med. Times and Gaz.*
9½	15	...	...	"The leg is strong, and the patient can walk well with a boot six inches high."

No.	Name of operator.	Sex and age of patient.	Date of operation.	Date of measurement.	Amount of bone removed.	From iliac spine to internal malleolus.		Of femur.	
						Operated limb.	Opposite limb.	Operated limb.	Opposite limb.
13	Jones, of Jersey	Lad, about 12, named John à Gros.	Between 1850 and 1854	March, 1862	Considerable portion of both bones	22	31	11	15
14	Firth	Boy, æt. 13	June, 1857	July, 1861	$1\frac{5}{8}$ths inch from both	$3\frac{1}{2}$ in. short	...	...	...
15	Syme	Boy	...	...	Articular surfaces; bulging parts left	"At first limb little inferior to in length till it was several *Journal*, 1859, p. 961.			
16	Price	Girl, æt. 15	May, 1856	Oct., 1861	1 inch of femur; $\frac{5}{8}$ths inch of tibia	25	29	12·3	15·5
17	Evan Thomas	Boy, æt. 12	March, 1853	Sept., 1861	Articulating end of femur; $\frac{1}{2}$ inch of tibia	28·5	33	14·5	16·5
18	Kendall	Girl, æt. 3	April, 1857	Sept., 1861	About $\frac{3}{4}$ths inch of femur, and $\frac{1}{4}$th inch of tibia	$16\frac{3}{4}$	$21\frac{3}{4}$	$8\frac{1}{2}$	10

The information given in the accompanying table, in the instances in which the source is not specified, was kindly supplied to me by the operators or their friends. The following particulars which I have received respecting other cases may spare some trouble to those who may be disposed, at a future time, to investigate this subject, and they are important as bearing upon the general question of excision of the knee. Mr. Coe, of Bristol, writes, that his first case, a boy, æt. 6, operated on Feb., 1856, turned out admirably, but the patient has left the neighbourhood. In the second case, a boy, æt. $4\frac{1}{2}$, operation, August, 1856, he was "obliged to amputate for acute necrosis of the shaft of the femur, which came on subsequent to the excision;" he recovered. Mr. Hey, of Leeds, amputated the limb about a year after excision in the case of a girl, æt. 11, who was operated on May, 1856; she recovered. He was also obliged to amputate a year after excision in

Of tibia.		Of foot.		Present condition of limb.
Operated limb.	Opposite limb.	Operated limb.	Opposite limb	
11½	15	8	8¾	"Well nourished, but much distorted. Can walk any distance, using a boot eight inches high. Has on several occasions escaped from the union by jumping a wall fifteen feet high."
12	14	...	...	"Bones firmly consolidated; with high-heeled shoe can walk considerable distance."—*Med. Times and Gaz.*, July 20th, 1861.
its fellow; gradually diminished inches		short."— *Brit. Med.*		
11·5	13·5	7·5	8·3	"Union firm. Patient can walk by means of an iron attached to an ordinary boot two or three miles without fatigue."
12·5	14·5	8·6	10·2	"Perfect use; is a factory lad; labour requiring considerable activity."
8	11	5	5	"By means of a patten attached to a boot, can run about and play like another child. The limb does not grow, at least in proportion to the rest of the body, if at all."

another case, a female, æt. 36, in consequence of want of union between the bones; this patient recovered. Mr. Evan Thomas's second case, a boy æt. 16, operated on November, 1853, "turned out badly; the thigh was amputated, but he did well notwithstanding." Mr. Godfrey, of St. Heliers, Jersey, who was so good as to send me the measurements of Mr. Jones's two cases, says—"Mr. Jones operated on several more; but some are since dead, and others have left the island. Le Femore, a lad æt. 17, died of phthisis. Livermore, another lad of about the same age, had his knee-joint excised; and two years after the disease reappeared in the hip, and he died in consequence. Two others, who recovered perfectly, died of typhus fever." Messrs. Bowman, Barnard Holt, Borlase Childs, and Fergusson are unable to give particulars of the present state of the children operated on by them. I have failed to obtain any account of the cases operated on by Mr. Statham and Mr. Cotton.

The effect of Rickets on the growth of the body.

In visits to various pathological museums, in this country and on the Continent, during the last two or three years, I took measurements of numerous rickety skeletons and bones. They are given in the table at the end of this paper, and they show, on the whole, considerable uniformity as to the relative degree in which the growth of the several bones is influenced by that disease.

The averages deduced from those measurements are thrown together in the following table, and compared with the normal averages of the corresponding parts. Adult specimens only have been included. The measurements are given in inches.

TABLE II.

	Normal.	Rickets.	Difference.
Height of skeleton	65·	44·	21·
Circumference of skull (round frontal and occipital protuberances)	20·5	19·6	·9
Face (result of measurements in two directions, one from fronto-nasal suture to lower edge of upper maxilla, the other from external auditory foramen to intermaxillary suture)	7·2	6·7	·5
Lower jaw (from angle to middle line and from condyle to angle)	6·4	6·	·4
Spine	22·2	19·9	2·3
Upper limb	29·2	22·4	6·8
Humerus	12·7	9·1	3·6
Radius	9·2	7·	2·2
Hand	7·3	6·3	1·
Clavicle	6·	5·1	·9
Lower limb	42·8	29·9	12·9
Femur	17·8	10·8	7·
Tibia	14·4	11·4	3·
Foot	10·6	7·7	2·9
Pelvis, transverse diameter	5·2	4·9	·3
Antero-posterior diameter	4·3	2·9	1·4
Os innominatum (depth and inner edge)	13·8	12·1	1·7
Sacrum (depth and width)	9·4	8·6	·8

It is evident that a deficiency of growth is a very general concomitant of the rickety state. The exceptions to this are few. It is commonly evinced in all parts of the frame, whether they are affected with curvature or not; hence the average height of rickety persons falls considerably below the normal standard. The deficiency indicated in the above table, amounting to one third, is partly explained by the curvatures in the spine and other parts, and is not, therefore, quite a fair estimate. Allowance, however, being made for this source of error, there still remains considerable difference between the rickety and the natural standard.

The deficiency is most marked in the *limbs*. The upper limbs are little more than three quarters of the ordinary length, and this is so although the usual evidences of rickets are shown in them in but few of the specimens that I measured. When curvatures take place in the upper limbs, it is, for the most part, in early life (from two to five years), the disease is in a severe form, and the child does not live long. Accordingly I found several specimens of children with deformity of the upper limbs, but the skeletons were so distorted that I could not make satisfactory measurements.

In the upper limb the segment which is most stunted is the arm. In none of the instances examined did the humerus show the average normal length; and the collective result given above shows it to be a third shorter than natural, and that it bears to the rest of the limb the proportion of 1 to 2·5, instead of 1 to 2·3.

The want of proper growth is still more apparent in the lower limbs. They are less than three quarters of the proper length (the bones were all measured along the curves); and the deficiency is greater in the femur than in any other part of the skeleton. The longest specimen that I found measured only 15 inches, and the average length is 10·8 inches, that is, not nearly two thirds of what it ought to be. Indeed, the average length of the femur in these cases falls short of that of the tibia, instead of exceeding it, as it should do, by three inches or more.

In no less than thirteen instances the two thigh-bones are of unequal length, the difference varying from half an inch to two and a half inches. An inequality, to a slight extent, between the corresponding bones of the two sides is noted in some other parts of the skeleton—in the arm in three instances, in the forearm in one, in the leg in three. It will be observed that in each of the instances in which there is an inequality in the length of the forearms or of the legs (Table III, Nos. 8, 10, 11, 18), the inequality is in some measure compensatory to that in the arms and thighs; that is to say, the forearm is short on the side opposite to that on which there is shortness of the arm, and the leg is short on the side opposite to that on which there is shortness of the thigh. It does not, however, therefore follow that the inequality in the one segment has taken place as a compensation for the inequality in the other, still less that there has been an increase of growth in the bones of the one part to make amends for the deficiency in the other. An examination of the specimens proved pretty clearly that the want of symmetry between corresponding parts has been caused in each case, not by an increase of growth on the longer side, but by an arrest of growth on the shorter side.

The collected measurements of the *pelvis* show that, in the rickety subject, it is one eighth smaller than natural. The greatest deficiency is the antero-posterior diameter. This is in part due to the frequent flattening of the pelvis, which may be caused, either by compression of the pubic part of the ring or by preternatural flexure in the hinder part of the iliac bones, allowing the sacrum to be approximated too closely to the pubes. This flexure takes place just above the sciatic notch, where ossification of the ilium commences, and is an illustration of the tendency of bones to yield, in rickets, at the points at which ossification first takes place. They are the points upon which the stress of bodily weight and muscular force is earliest and most felt, and which are most dependent for their resisting properties upon a timely and sufficient calcification of the osseous structure. Another part of the circle of the pelvis which is liable to yield, and

which is also a starting point of calcification, is in the pubes, near the acetabulum. When both these parts yield, the acetabulum is projected into the cavity of the pelvis; and if it be on both sides, the upper aperture of the pelvis acquires the triradiate form which is so often met with in the severe cases of rickets.

In the *skull* the deficiency of growth is less marked than in any other part of the body. The calvarium is only one twenty-second, and the face one fourteenth below the natural standard.

The deficiency in the spine[1] (about one tenth of the normal proportion) is less than might have been expected from the frequency with which this part is affected with curvature.

These results correspond generally with those obtained by Mr. Shaw[2] from the measurement of ten rickety skeletons, more particularly with regard to the deficient growth of the limbs and of the pelvis, that is, of the parts the growth of which goes on most quickly after birth. The deficiency is also shown to be greater in the lower limbs than in the upper, though the difference is not so great as in the instances given by Mr. Shaw. In seven rickety specimens measured by that gentleman the average dimensions of the face were found to fall short of the normal size by one fifth,

[1] The spine, as well as the long bones, was, in each instance, measured along the curves.

[2] 'Medico-Chirurgical Transactions,' xvii, p. 434. My own observations confirm the important statement made by Mr. Shaw, p. 439, that "in whatever state of distortion the spine and ribs may be, the bones of the pelvis will not be found distorted unless there be at the same time marks of rickets in some of the long and solid bones;" though I am by no means, on that account, disposed to assent to the view that the distortion of the spine is of a different nature from that of the pelvis and of the long bones. On the contrary, curvature of the spine is very often associated with curvatures of the other parts of the skeleton; and when it is so, the curvature is precisely of the same nature as when it exists alone. The shortness of the bones in rickets has been noticed by Glisson, 'De Rachitide,' p. 278; by Stanley, 'Diseases of the Bones,' p. 224; and others. The "method," as it may be called, of the shortness, was pointed out by Mr. Shaw, and measurements upon a more extended scale do little more than confirm and somewhat extend this method.

whereas my own measurements make the deficiency only one fourteenth.

I have already indicated that the deficiency of length in each limb is most marked in its proximal segment, and that this is more particularly the case in the lower limb. It is, on the whole, least apparent in the distal segment of the upper limb. These points are interesting in connexion with the fact that in the advance from the infantile to the adult state the proximal segments of the limbs, especially of the lower limb, elongate more rapidly than the other parts, whereas the contrary is the case with the distal segments. These, especially the hand, grow relatively more slowly than the other parts. The adult type of the limbs differs from the infantile type chiefly in the great proportionate length of the humerus and the femur; the limbs of man are distinguished from those of the ape and of most of the lower animals by the same feature, and the influence of rickets in arresting growth is displayed upon these bones more than upon any others. Further, all these observations apply to the femur in a greater degree than to the humerus.

The shortness of the bones in rickets has no necessary connection with the abnormal curvatures. Some of the bones in which it is most marked are as straight as natural. Moreover it is most commonly observed in the thigh-bones, whereas the curves are most frequent in the tibia and fibula. Again, the bones of the upper limbs are usually short in rickets, and but seldom curved.

An examination of the tables shows that shortness is a more constant feature of the rickety state than curvature, for in skeletons of which a few bones only are curved all the bones are frequently seen to be short. In other words, the evidences of deficient growth are witnessed in rickets more frequently than those of deficient calcification; and we must not be content to regard the disease as one consisting in an imperfect supply of earthy matter in the bones, and in deformity consequent therefrom. The failure is of a more radical nature than this simple idea conveys.

In the growth of bone three processes are concerned. First,

The generation—"proliferation" it is sometimes called—of cells in the cartilaginous or sub-membranous matrix. Secondly. The transformation of those cells, the production of the intercellular structure, and the resorption of the latter at various parts, so as to give rise to the cavities and canals of bone. And thirdly. The infiltration of earthy matter or calcification. Of these the second process appears to go on much as usual in rickets. The concurrent testimony of Meyer, Kölliker, Virchow, Tomes, and De Morgan, is to the effect that the cells go through the various changes requisite for the formation of bone; but that the addition of earthy matter, constituting the third process, does not take place in sufficient quantity, and that the structure remains, more or less, in a state of what may be called soft or uncalcified bone. The quantity of bone produced depends upon the amount of cells produced, and the small dimensions of the bones in rickets show that the first, or cell-producing, process is conducted at least as imperfectly as the third or calcifying process.[1]

I say small dimensions; for the deficiency of growth, as a general rule, is evident, not only in the shortness, but in the thinness of the bones. They are usually small in every direction. In the four instances in which any mention of the condition of the skull is made in my notes (Nos. 2, 21, 24, 34), it is described to be thin.

To this, however, there are many exceptions, for bone formation and bone absorption also are apt to go on very irregularly in rickets, being subject to other influences besides the natural stimulus of growth. A condition some-

[1] The last-mentioned observer, 'Philosophical Transactions' for 1853, p. 126, examined the rickety bone of a child who died during the active condition of the disease, and found that "cartilage had assumed the arrangement of bone without the impregnation of earthy ingredients." The preternatural growth of cartilage-cells, mentioned by Virchow, 'Archiv,' v, 487, can scarcely be an ordinary phenomenon in rickets, but may accompany those hurried processes of bone formation which occasionally supervene in rickets, and which are referred to in a following paragraph.

what resembling, perhaps similar to, inflammation not unfrequently supervenes, in which the bones become more or less thickened, or swollen and roughened by the addition of porous, crumbling, imperfect, osseous matter. This may gradually be smoothed and solidified, and the structure of the bone may be condensed by a similar process going on in its caucelli and Haversian canals, so that rickety bones are often exceedingly thick, heavy, and hard, and the skull, as is well known, occasionally attains enormous size and weight in these cases. Such changes are due to causes quite different from growth, and they have no *necessary* connection with rickets, though they are often *contingent* on the rickety state.

A morbid rapidity of osseous absorption may attend upon this morbid rapidity of osseous formation, and may even exceed it. Hence the interior of the bones may be rendered more porous than natural, or may be hollowed out into cavities containing serous and sanguineous fluids, while the exterior is being encrusted with unhealthy, pumice-stone-like, osseous substance. Such changes occur only in young subjects, and are foreign to the purport of this communication.

In the examination of the specimens from which the accompanying tables are compiled, I was soon struck by the remarkable bulging and knottiness of many of the bones about their epiphysial lines; the appearance presented being precisely as if the bones, when in a soft state, had been squeezed out at these parts by pressure made upon the two ends. There is very little doubt that this has actually taken place. The calcification of the cartilage-structure in the epiphysial lines not proceeding at a rate proportionate to its growth, the part has yielded or bulged in the whole circumference, and then has become calcified in this unnatural condition. Thus, the cartilaginous growth in the epiphysial lines, instead of contributing to the length of the bones, has been a means of increasing their thickness and deformity.

This deformity is chiefly observed in those bones which have most failed to attain their proper length, and it must

be intimately related to that failure. The quick growth of epiphysial cartilage at the lower end of the femur, double as great as at any other part of the skeleton, causes the effects of imperfect calcification of the cartilage to be peculiarly manifest there. Accordingly we find the bulging of the epiphysial lines very frequent, and very marked in this situation (Plate VII, Figs. 5, 6, 7). It is also sometimes seen at the upper end of the humerus (Figs. 8, 9), and is quite distinct at the lower end of the shorter of the two tibiæ, where there is a disparity of length in those bones (Fig. 5). Probably, in these leg-bones, as well as in the examples of disparity between the two thigh-bones, the yielding of the epiphysial lines has been the cause of the shorter bone not keeping pace with its fellow.[1]

Sometimes the yielding takes place over one of the condyles of the femur to a greater extent than over the other, which prevents that condyle descending to its proper level, and induces an obliquity in the articular surface of the tibia, thus giving rise to "knock-knee" or "bow-knee," according as the failure is most above the outer or the inner condyle. Although the effects of the yielding are traceable in most instances in which there is much deficiency of growth, it is not so always. I have seen specimens of very short rickety bones, in which, neither on the exterior nor in the section, was there any abnormal appearance at the epiphysial lines. There is such a femur in the museum of Middlesex Hospital. It is in all respects a small bone, but the articular ends are well formed.

The bulging of the epiphysial lines, with the consequent spreading out of the bones near their articular ends, is to be distinguished from the swelling of the ends of the bones which sometimes takes place in rickets, though I suspect it

[1] Virchow, "Das normale Knockenwachsthum und die rachitische Störungen desselben," Virchow's 'Archiv,' v, 409, mentions the spreading of the epiphysial lines under the weight of the body and the action of the muscles, in consequence of the growing cartilage-cells not becoming duly impregnated with earthy matter.

has often been confounded with it. This swelling affects the whole spongy ends of the bones, and not merely, or even chiefly, the epiphysial lines, and it does not seem to affect the growth of the bones. It is not observable in any of the specimens I have measured. Indeed, I believe it is confined to very early life, occurring at the sternal ends of the ribs before birth, and at some other parts in early infancy. I have often seen it in little children at the lower end of the radius, and in one instance it was attended with suppuration, but I have not found any well-marked specimens of it in that situation in museums.

In like manner, the bulging and knottiness at the epiphysial lines are to be distinguished from the thickening of the articular ends, with knottiness of the articular margins, which is an attendant upon chronic rheumatic arthritis. In the latter affection the cartilages are removed, the articular surfaces of the bones are worn away, and the substrata are polished by the friction consequent on the movements of the joints. The bony deposit which is contemporaneous with these changes takes place, first and chiefly, as I have just hinted, upon the edges of the articular surfaces. Whereas in rickets the cartilages and the articular surfaces remain unimpaired, and the bony outgrowths are first and chiefly at the epiphysial lines. The two conditions may, however, coexist, or rather, that of arthritis may be superadded to that of rickets. (Table III, Nos. 12, 14, 35, 45, 57.)

It may be questioned whether I have been justified in including the first five skeletons in a table of specimens of rickets, forasmuch as those skeletons are remarkable chiefly for their dwarfish character, and do not present many of the usually recognised features of the rickety condition. I have classed them with the others, because the deficiency of growth, which they so remarkably exhibit, is, as above shown, one of the usual associates of rickets. Secondly, all these skeletons have more or less distinctly that bulging and nodulation at the epiphysial lines which is one of the

most characteristic indications of the rickety state. Thirdly, three of the skeletons have unnatural curvatures in the spine or pelvis. Fourthly, there is a general similarity between the bones of these dwarfish skeletons and those of the other rickety skeletons, which is more particularly noted with regard to Nos. 30, 39, and 43.

No.	Reference to museum.	REMARKS.	SEX.	Age.	Height.	Circumference of skull round frontal and occipital protuberances.	FACE.	
							Depth of, from fronto-nasal suture to lower edge of upper maxilla.	Length of, from external auditory foramen to inter-maxillary suture.
1	Musée Dupuytren, at Paris, No. 516	Short person. Curvatures in spine, not in limbs. Ends of long bones all enlarged and nodulated. Scapula as long as the humerus. The deficiency in antero-posterior diameter of pelvis appears to result from the sacrum having been pressed a little forwards.	F	Adult	29	18·8	2·5	4·4
2	Strasburg, No. 250	No curvatures in limbs or spine, only in pelvis; the sacrum and hinder parts of iliac bones advanced forwards. Bones small; but ends of long bones large, from bulging and nodulation at the epiphysial lines. Points of attachment of muscles prominent. Fibulæ rather long, extending above and below the usual points of relation to the tibiæ. Necks of thigh-bones very short, with marked bulging at the lines of contact with the heads. The angles formed by them with the shafts natural. Articular surfaces all natural. Skull rather thin. Man said to have been very strong, by no means deficient in intellect.	M	55	43	23·0	2·5	—
3	St. Bartholomew's, *a* 152	One sharp bend backwards in lower part of back. No curves in bones; but knotty state of epiphysial lines. Articular surfaces natural. Flattening of pelvis.	F	Adult	48	21·5	2·8	5·0
4	Vienna, No. 58	No unnatural curvatures. Bones small and knotty. Bulgings of epiphysial lines near knee and in humerus, not in other parts.	M	40	47	22·0	—	—
5	Norwich	A man named Pycroft, hung for murder. No unnatural curves; but marked bulging in the epiphysial lines, especially of the thigh-bones.	M	Adult	44	19·0	2·5	5·0
6	Musée Dupuytren, No. 517	Thigh- and leg-bones rickety. No apparent cause for the difference in length between the two thigh-bones, except that the left is more deformed, more bent, and more spread out near the lower end than the right. It seems that the growth of the shaft has been arrested at this part; but not at this part only, for the measure of the bone from the head to opposite the divergence of the linea aspera where is the hole for the nutritious artery is 6·2, whereas in the right thigh-bone it is 7·2. The angle of the neck with the shaft is the same in each bone. The leg-bones are much more bent than the thigh bones.	—	Adult	—	—	—	—
7	Ditto, No. 518	Thigh- and leg-bones rickety.	—	Adult	—	—	—	—
8	Ditto, No. 519	Rickets of thighs, legs, and pelvis. The upper ends and the upper parts of the shafts of the two thigh-bones are alike in length and in degree of curvature. The lower part of the right is more spread out and nodulated about the epiphysial line than the left. In the case of the leg-bones the lower end is more spread out in the left than in the right. The left astragalus and the ankle-joint are much deformed. The pelvis is deformed from flexures in the iliac bones. (Plate vii, fig. 5).	F	Adult	45	—	—	—
9	Ditto, No. 520	Rickets of spine, lower limbs and pelvis, the latter compressed antero-posteriorly. The right thigh-bone rather more bent than the left; both much spread out at lower end. The upper epiphysial line of the left humerus bulging and nodulated (Plate vii, fig. 8.)	F	Senile	45	—		—
10	Ditto, No. 5.1	Rickets of spine, limbs, and pelvis. The latter triradiate, the left acetabulum having been pressed inwards. The right humerus flattened at the upper end, and tuberculated about the epiphysial line; also tuberculated about lower end and bent outwards, so as to render articular surface oblique. Both thigh-bones much spread out at lower ends, nodulated about epiphysial lines.	F	Adult	—	15·2	2·2	4·0

Lower Jaw.												Sacrum.		Pelvis.			
Length from angle to middle line.	Depth from condyle to angle.	Depth from alveolar edge to lower edge.	Spine.	Clavicle.	Humerus.	Radius.	Hand.	Femur.	Tibia.	Foot.	Width.	Depth.	Transverse diameter.	Antero-posterior diameter.	Inner edge of innominate bone from symphysis pubis to sacrum.	Depth of innominate bone from crest to tuber ischii.
3·4	2·2	1·2	15·0	4·5	4·5	3·0	4·5	6·5	6·0	4·6	4·0	4·3	4·5	3·0	4·6	9·0
—	—	—	—	5·0	6·5	5·0	6·0	9·0	7·0	7·0	—	—	4·5	1·6	—	—
—	—	—	—	5·0	7·8	6·0	6·5	10·5	8·4	7·5	—	—	4·5	2·3	—	—
4·3	2·5	1·3	20·0	5·0	6·0	4·8	5·8	8·5	6·5	7·0	3·0	4·0	4·0	2·2	4·0	6·0
4·4	2·5	1·3	24·0	5·5	6·5	5·9	6·3	9·5	7·6	8·0	3·8	4·5	4·4	1·5	4·0	6·5
3·3	1·8	1·0	19·0	—	—	—	—	Right 11·2 Left 9·4	Right 10·5 Left 10·5	7·0	4·0	4·3	4·5	3·0	4·6	9·0
3·5	2·0	1·0	20·5	—	—	—	—	9·5	11·0	6·5	4·4	3·5	5·5	2·6	4·5	7·0
3·5	2·3	—	19·0	5·0	10·5	7·0	6·8	Right 9·5 Left 13·0	Right 11·6 Left 10·2	8·0	4·4	3·8	5·2	3·0	5·5	7·0
3·5	2·0	—	18·5	5·5	Right 10·2 Left 9·5	7·5	6·5	Right 9·5 Left 10·0	12·0	8·0	4·0	3·5	5·5	3·3	5·0	7·0
3·4	2·1	—	16·0	4·5	Right 7·1 Left 8·6	Right 6·4 Left 6·0	5·5	9·5	9·5	7·0	4·2	4·0	4·8	2·8	4·5	5·6

No.	Reference to museum.	REMARKS.	SEX.	Age.	Height.	Circumference of skull round frontal and occipital protuberances.	FACE.	
							Depth in mm. from inner angle of eye to lower edge of upper maxilla.	Length of, from external auditory foramen to inter-maxillary suture.
11	Musée Dupuytren, No. 522	Severe rickets in spine, slight in lower limbs. Right tibia more bent than the left; its lower half and the foot inclined outwards; slight nodulation about its upper epiphysial line, and a small exostosis on the inner side of its epiphysis. The right fibula does not accurately follow the curve of the tibia, and is an inch shorter than the left.	—	Adult	56	25·0	3·0	4·8
12	Ditto, No. 523	Severe rickets in spine and lower limbs. Lower ends of thigh-bones much deformed, especially that of the left. In addition to the squeezing out of the epiphysial lines there is an eroded condition of the articular surfaces, with nodulation of their edges, the result of chronic rheumatic arthritis. This is also the case in the tibiæ, but they are not deformed.	—	Senile	45	16·5	—	—
13	Ditto, No. 524	Rickets in spine and lower limbs. Lower ends of thigh-bones spread out in the epiphysial lines. Leg-bones more bent than the thigh-bones.	F	Young adult	37	18·0	2·3	3·5
14	Ditto, No. 524 *a*	Rickets in pelvis and lower limbs. Both thigh-bones spread out at epiphysial lines, also nodulated at the articular margins from chronic rheumatic arthritis. Flexures in both iliac bones.	F	Adult	37	16·2	2·5	4·8
15	Ditto, No 531 *a*	Rickets in spine and lower limbs. Bulging epiphysial lines.	F	Adult	42	19·0	2·2	4·2
16	Ditto, No. 531	Very short skeleton. Slight rickets and bulging of epiphysial lines.	—	Senile	—	20·0	—	—
17	Ditto, No. 537 *a*	Lower part of skeleton only preserved. Bones not much bent but thigh-bones, especially the right, much squeezed out at the epiphysial lines.	—	Adult	—	—	—	—
18	Ditto, No. 530	Lower part of skeleton only preserved. Thigh, and leg-bones much spread out at epiphysial lines near the knee.	—	Adult	—	—	—	—
19	Ditto, No. 494 *a*	Pelvis and thigh-bones only preserved; the former much flattened from before backwards; the latter much squeezed out at the lower epiphysial lines.	—	Adult	—	—	—	—
20	Ditto, No. 502	Rickety femur and tibia. The squeezing out at lower epiphysial line of femur very remarkable (Plate vii, fig. 7).	—	—	—	—	—	—
21	Strasburg, S. 91	Severe rickets in pelvis and lower limbs, slight in upper limbs. Flexures in iliac bones near sacrum. Some flattening and thickening of upper ends of arm-bones, more marked about lower epiphysial lines of thigh-bones. Skull thin.	F	63	30	16·6	2·6	4·0
22	Ditto, S. 94 *a*	Skull, pelvis, and lower limbs, only preserved. Marked bulging in lower epiphysial lines of thigh-bones. Flexures in iliac bones near sacrum.	M	Senile	—	24·0	—	—
23	Ditto, S. 90	Rickets of lower limbs and forearms; slight in back. Left acetabulum pressed in a little. Tibiæ much bent. No distinct thickening of ends of bones.	F	22	42	21·0	2·4	4·5
24	Zurich	Rickets of spine and lower limbs, especially of legs. Bones of legs bent backwards. Nothing remarkable about articular ends. Pelvis deformed from left acetabulum being pressed nearly to sacrum. Skull rather thin.	F	Senile	52	20·3	—	—
25	Ditto	Rickets of spine; slight of lower limbs. Nothing remarkable in articular ends of bones. Necks of thigh-bones at right angles with shafts. Pelvis rendered triangular by slight bend in iliac bones.	M	Adult	48	20·0	2·8	4·5

Lower Jaw.											Sacrum.		Pelvis.			
Length from angle to middle line.	Depth from condyle to angle.	Depth from alveolar edge to lower edge.	Spine.	Clavicle.	Humerus.	Radius.	Hand.	Femur.	Tibia.	Foot.	Width.	Depth.	Transverse diameter.	Antero-posterior diameter.	Inter edge of innominate bone from symphysis pubis to sacrum.	Depth of innominate bone from crest to tuber ischii.
4·4	2·2	1·2	20·0	5·5	12·6	9·5	7·5	15·0	Right 13·6 Left 14·2	9·5	4·4	4·4	5·4	4·0	5·4	8·0
3·5	2·0	—	20·0	5·0	10·0	7·5	6·5	Right 11·0 Left 9·0	11·5	8·5	4·5	3·5	5·4	4·0	5·4	8·0
3·5	1·8	1·0	20·0	4·5	7·5	5·5	5·0	Right 10·0 Left 10·4	11·0	7·0	4·4	3·0	4·6	2·8	5·0	6·5
4·0	2·2	1·0	21·5	5·0	10·0	7·5	6·5	Right 11·5 Left 10·5	12·5	8·0	5·0	4·5	5·6	4·4	6·0	8·0
3·6	2·3	1·0	19·0	5·1	10·0	7·5	6·5	12·4	12·1	8·0	4·5	4·5	5·5	3·0	5·5	7·0
—	—	—	—	5·2	9·2	7·5	6·0	10·5	11·0	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	Right 8·5 Left 10·5	11·2	8·0	—	—	4·4	3·4	—	—
—	—	—	—	—	—	—	—	Right 10·0 Left 11·0	Right 9·5 Left 8·5	8·0	—	—	—	—	—	—
—	—	—	—	—	—	—	—	Right 10·5 Left 10·0	—	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	8·5	12·0	—	—	—	—	—	—	—
—	—	—	—	5·2	9·0	7·0	6·5	11·0	11·0	7·5	—	—	5·0	2·0	—	—
—	—	—	—	—	—	—	—	11·0	11·0	—	—	—	4·5	2·0	—	—
—	—	—	—	4·8	10·0	6·5	6·0	12·0	10·0	7·5	—	—	4·6	3·6	—	—
—	—	—	—	5·0	9·5	7·5	6·5	12·5	10·5	7·5	—	—	—	—	—	—
—	—	—	—	5·8	10·3	8·5	6·8	14·0	12·5	8·3	—	—	5·0	3·3	—	—

No.	Reference to museum.	REMARKS.	Sex.	Age.	Height.	Circumference of skull round frontal and occipital protuberances.	FACE.	
							Depth of, from fronto-nasal suture to lower edge of upper maxilla.	Length of, from external angular process to inter-maxillary suture.
26	Lyons	Rickets in spine, lower limbs, and pelvis. The latter triradiate. Extreme flattening of lower ends of thigh-bones from squeezing out of epiphysial lines. The same at upper ends of arm-bones less marked. Necks of thigh-bones at right angles with shafts. Fibulæ long in relation to tibiæ.	F	50	38	19·0	—	—
27	Bonn	Negress. Rickets of spine, pelvis, and lower limbs. Marked bulging of upper epiphysial line of left humerus and of lower epiphysial lines of thigh-bones.	F	50	41	20·5	2·2	4·0
28	Ditto	Rickets of spine and lower limbs.	M	Adult	—	21·0	2·5	4·5
29	Ditto	Rickets of pelvis and lower limbs.	M	Adult	54	21·0	2·4	4·5
30	Ditto	General rickets. Arm- and forearm- bones precisely resemble those of short skeletons, Nos. 1 to 5. This woman said to have been delivered three times by Cæsarean operation. The children alive, of fair size.	F	Senile	30	19·0	2·3	4·0
31	Ditto	General rickets, severe. Bulging condition of ends of thigh-bones and tibiæ, and of upper ends of arm-bones.	F	Senile	—	21·5	—	4·0
32	Frankfort	Severe general rickets.	—	Senile	45	20·3	2·0	3·5
33	Ditto	Rickets of pelvis and lower limbs.	—	Senile	—	—	—	—
34	Munich	General rickets. Bulgings of upper epiphysial lines of arm-bones and of lower ones of thigh-bones very marked. Skull thin.	M	42	39	19·5	2·0	4·0
35	Ditto	Rickets of spine and lower limbs. Thigh-bones with bulging lower epiphysial lines, and projecting, nodulated, articular margins.	F	Adult	44	19·2	2·4	4·2
36	Ditto	Rickets of lower limbs, and slight of pelvis.	—	Adult	—	—	—	—
37	Vienna	Rickets of spine, pelvis, and limbs. Bulging at epiphysial lines very marked in arm- and thigh-bones. Woman underwent Cæsarean operation.	F	30	43	18·0	2·3	4·3
38	Ditto	Rickets of arms, lower limbs, and pelvis. Thigh-bones very thick and bent, with bulging epiphysial lines.	F	30	41	19·0	2·3	4·0
39	Ditto	Rickets of spine, pelvis, and limbs. The legs crumpled up beneath pelvis. Marked bulging of epiphysial lines at upper part of leg- and arm-bones, and at lower parts of thigh-bones. Arm- and thigh-bones small and knotty, like those in the short skeletons (1 to 5). Thinness of parietal bones on sides of sagittal suture.	F	64	40	18·0	2·3	4·3
40	Edinb. Col. Surgeons	Rickets of spine and lower limbs.	F	Adult	50	19·5	2·5	3·4
41	Ditto	Severe rickets of lower limbs, pelvis narrowed antero-posteriorly. Spine straight. Arm-bones very knotty and thick at upper ends, about epiphysial lines.	F	Adult	41	19·5	2·5	3·7
42	Ditto	Severe rickets of spine and lower limbs. Great bulging of epiphysial lines near knee and shoulder.	F	Adult	36	20·0	2·5	4·5
43	King's College, No. 1295	Rickets of legs, slight of thighs. Spine bent backwards. Shortness of forearms and hands remarkable. Shoulders and elbows affected with rheumatic arthritis.	M	Adult	48	18·6	2·4	4·4

Lower Jaw.										Sacrum.		Pelvis.			
Length from angle to middle line.	Depth from condyle to angle.	Depth from alveolar edge to lower edge.	Spine.	Clavicle.	Humerus.	Radius.	Hand.	Femur.	Tibia.	Foot.	Width.	Depth.	Transverse diameter.	Antero-posterior diameter.	Inner edge of innominate bone from symphysis pubis to sacrum.	Depth of innominate bone from crest to tuber ischii.
—	—	—	—	5·2	9·2	6·8	5·6	8·0	8·0	7·0	—	—	—	—	—	—
3·5	2·0	1·1	18·0	5·1	Right 9·0 Left 8·0	Right 7·2 Left 7·2	—	6·0	11·5	—	4·0	4·5	5·0	3·5	4·5	6·5
4·0	2·5	1·2	33·0	6·5	12·5	10·0	8·0	16·5	15·0	9·5	5·0	5·5	5·5	3·5	5·4	9·0
4·1	2·5	1·2	24·0	6·2	12·0	8·5	7·5	15·0	13·0	8·5	5·0	5·0	5·5	2·5	4·8	8·0
4·0	2·0	1·0	14·0	5·0	7·8	5·4	6·0	8·0	6·5	—	—	—	—	—	—	—
4·0	2·1	—	16·0	5·0	9·0	7·0	6·5	11·0	11·0	—	4·3	—	4·5	2·0	4·4	6·0
5·0	2·0	—	16·0	5·3	9·4	7·4	7·0	12·5	11·0	8·0	·0	4·0	5·0	2·5	4·5	6·0
—	—	—	—	—	—	—	—	12·5	11·5	7·0	4·8	4·0	5·4	2·4	4·5	7·0
3·5	1·8	1·0	15·0	4·5	7·5	5·5	6·0	10·0	10·5	7·0	4·0	3·5	4·3	1·7	4·0	5·5
3·5	2·5	1·4	19·0	5·0	10·0	8·0	7·0	10·0	11·0	8·5	4·5	5·0	6·0	3·4	5·2	7·5
—	—	—	—	—	—	—	—	11·0	12·6	9·0	4·5	4·5	6·0	3·8	5·5	7·8
4·0	2·0	1·0	22·0	5·2	9·4	7·2	6·5	10·5	10·5	8·0	5·0	4·0	5·5	2·0	4·5	7·0
3·5	2·1	1·0	21·5	5·3	10·0	8·0	6·5	11·5	13·0	9·0	4·5	3·6	5·5	2·3	5·0	7·0
4·0	2·0	1·0	19·0	5·0	7·5	6·5	6·0	9·0	7·0	7·0	4·5	3·0	5·0	2·0	5·0	6·5
3·6	2·2	1·0	23·0	4·6	9·7	7·2	6·5	Right 13·1 Left 12·1	Right 11·8 Left 11·8	8·0	4·5	4·5	5·5	3·0	5·0	7·5
3·9	2·8	1·2	21·0	5·0	8·5	6·0	6·2	10·1	9·5	8·0	4·3	3·3	5·0	1·5	4·5	6·5
4·0	2·5	1·0	23·0	5·0	8·5	7·0	6·0	10·0	9·0	7·0	4·5	3·3	5·0	3·0	5·0	6·5
—	—	—	—	5·7	9·7	6·0	5·5	14·5	13·0	8·7	—	—	4·6	4·0	—	

No.	Reference to museum	REMARKS.	Sex	Age.	Height.	Circumference of skull round frontal and occipital protuberances.	FACE.	
							Depth of, from fronto-nasal suture to lower edge of upper maxilla.	Length of, from external auditory foramen to inter-maxillary suture.
44	King's College, No. 1294	Rickets of spine and lower limbs. Pelvis compressed antero-posteriorly. Thigh bones very thick, bent, and squeezed out at lower epiphysial lines. Slight arthritis at knees.	F	Senile	46	12·0	—	—
45	Col of Surg. London, No. 2879 *b*	Rickets of spine, pelvis, and limbs. Left acetabulum approximated to sacrum. Thigh-bones very thick and bent, and squeezed out at lower epiphysial lines; upper ends well formed. Upper ends of arm-bones large, bulging, and knotty at the epiphysial lines, with some traces of chronic rheumatic arthritis in articular surfaces (Plate VII, fig. 9.)	M	Adult	47	23·0	2·4	5·5
46	Ditto, No. 2879 *a*	Rickety pelvis and thigh-bones.	—	Adult	—	—	—	—
47	Ditto, No. 2519 *a*	Rickety thigh, and leg-bones.	—	Adult	—	—	—	—
48	St. Bartholomew's, A. 149	Thigh-bones thick; lower ends much deformed, partly from arthritis, partly from epiphysial lines being squeezed out and knotty.	M	Adult	—	—	—	—
49	Ditto	Rickety pelvis, thigh, and leg-bones.	F	Adult	—	—	—	—
50	Ditto, A. 147	Rickety pelvis and thigh-bones. Marked bulging at lower epiphysial lines of thigh-bones.	F	Adult	—	—	—	—
51	Ditto, A. 146	Severe rickets of lower limbs and spine. Flexures in iliac bones.	F	Adult	—	—	—	—
52	Ditto, A. 164	Rickety pelvis and thigh-bones. Shafts of latter rather thick, not much bent, with marked bulging at epiphysial lines. Necks at right angles with shafts. Flexures in iliac bones.	F	Adult	—	—	—	—
53	Guy's, No. 1000[10]	Rickets of all the long bones. Nothing remarkable in the articular ends of any.	F	Adult	51	20·0	2·3	4·3
54	St. Thomas's, E. 59	Slight rickets of spine and lower limbs. Nothing remarkable in articular ends. Thigh-bones rather thick.	M	Adult	56	20·3	2·5	5·0
55	Ditto, E. 58	Slight rickets of spine and lower limbs. Bones of lower limbs thick. Articular ends well formed.	F	Adult	53	19·5	2·5	4·4
56	St. George's	Described by Mr. Hawkins, 'Med. Gaz.' i, 270. "Double curvature in spine; the pelvis twisted; all the long bones distorted and twisted in different directions."	M	Adult	47	19·2	2·0	4·3
57	University College	Rickets of lower limbs. Bulging and nodulation of lower epiphysial lines of thigh-bones very marked, especially on the inner side. The articular surfaces of inner condyles do not descend to the same level as those of outer condyles, so the woman must have been very bow-legged. Articular margins at some parts nodulated, and articular surfaces worn and porcelain-like.	F	Senile	45	20·5	—	—
58	Ditto	Rickets in spine, slight in lower limbs; pelvis triradiate.	F	40	40	—	—	—
59	Middlesex Hospital	Rickets in lower limbs and pelvis. Iliac bones bent.	F	Adult	54	20·0	—	—
60	Ditto	Rickets of spine, lower limbs, and pelvis. Bulging of lower epiphysial lines of thigh-bones and some flattening of articular surfaces. Flexures in iliac bones, eversion of tubera ischii.	—	—	—	—	—	—
61	King's College	Severe rickets and mollities, with giving way of bones. Thigh- and leg-bones bent forwards.	—	8 to 12	37	19·5	1·11	4·5

Lower Jaw.			Spine.	Clavicle.	Humerus.	Radius.	Hand.	Femur.	Tibia.	Foot.	Sacrum.		Pelvis.			
Length from angle to middle line.	Depth from condyle to angle.	Depth from alveolar edge to lower edge.									Width.	Depth.	Transverse diameter.	Antero-posterior diameter.	Inner edge of innominate bone from symphysis pubis to sacrum.	Depth of innominate bone from crest to tuber ischii.
—	—	—	—	6·0	10·2	9·0	7·0	11·5	13·5	8·0	—	—	—	—	—	—
—	—	—	—	5·2	9·2	8·7	6·7	10·5	13·0	8·0	—	—	—	—	—	—
—	—	—	—	—	—	—	—	13·5	13·0	—	—	—	4·6	2·8	—	—
—	—	—	—	—	—	—	—	13·0	13·0	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	Right 12·0 Left 9·9	Right 12·0 Left 12·0	—	—	—	—	—	—	—
—	—	—	—	—	—	—	—	14·0	12·5	—	—	—	5·3	2·7	—	—
—	—	—	—	—	—	—	—	11·5	13·0	—	—	—	5·5	3·3	—	—
—	—	—	—	4·5	8·5	6·5	6·0	9·5	10·4	7·0	—	—	5·0	2·6	—	—
—	—	—	—	—	—	—	—	10·0	—	—	—	—	5·5	1·5	—	—
—	—	—	—	5·2	10·3	7·2	7·0	13·0	11·5	8·0	—	—	5·0	2·5	—	—
—	—	—	—	5·2	10·5	8·0	7·5	14·5	13·0	9·0	—	—	5·0	2·8	—	—
—	—	—	—	5·4	10·6	7·5	6·7	14·0	11·4	8·5	—	—	5·1	3·5	—	—
—	—	—	—	5·0	10·5	7·5	6·5	Right 13·5 Left 11·5	11·6	6·7	—	—	—	—	—	—
—	—	—	—	4·8	9·0	6·8	6·5	10·0	11·3	7·5	—	—	4·8	2·8	—	—
—	—	—	—	—	9·5	6·5	—	11·0	10·5	7·5	—	—	—	—	—	—
—	—	—	—	4·6	9·5	7·3	6·5	13·0	12·5	7·5	—	—	—	—	—	—
—	—	—	—	5·0	9·5	7·5	6·5	Right 10·5 Left 11·0	11·5	—	—	—	5·0	2·3	—	—
—	—	—	—	3·5	6·0	4·5	4·5	8·5	6·0	—	—	—	—	—	—	—

DESCRIPTION OF PLATES VI AND VII.

Plate VI.

Fig. 1.—Photograph of patient with defective growth of lower jaw.

a. The chin. *b*. The position of the hyoid bone.

Fig. 2.—Side view of same, with lips held apart, to show the inclination of the teeth.

Plate VII.

Fig. 1.—Leg of girl, with curvature backwards, just below the knee.

Fig. 2.—Lower end of humerus and bones of left forearm from an adult. The end of the humerus is deformed. The ulna is short, and tapers at its lower end, without presenting any trace of an epiphysis. The radius is preternaturally curved; its lower articular surface is considerably below the lower end of the ulna, and is inclined towards the ulna; its upper end, deformed and tuberculated, lies upon the outer supracondyloid line.

Fig. 3.—Lower end of humerus and bones of right forearm, from the same man as preceding. The upper end of the ulna is anchylosed to the malformed lower end of the humerus. The position of the upper end of the radius corresponds with that in the preceding figure. The two bones at their lower part are well formed, and contribute, in a natural manner, to the wrist-joint.

Fig. 4.—Forearm of a girl with short ulna; the hand is inclined towards the ulnar side, and the radius is preternaturally arched.

A. Lower end of ulna.

B. Preternatural convexity of radius.

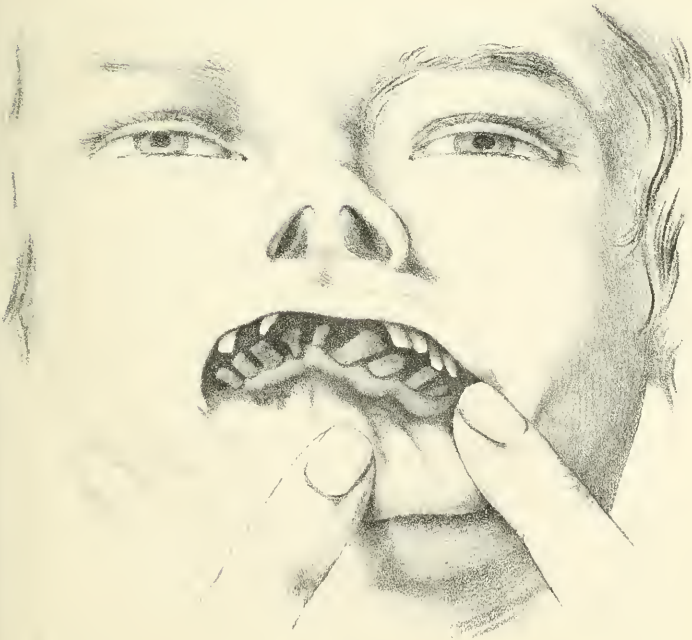
Fig. 5.—Rickety pelvis and lower limbs, from Musée Dupuytren (Table III, No. 8).

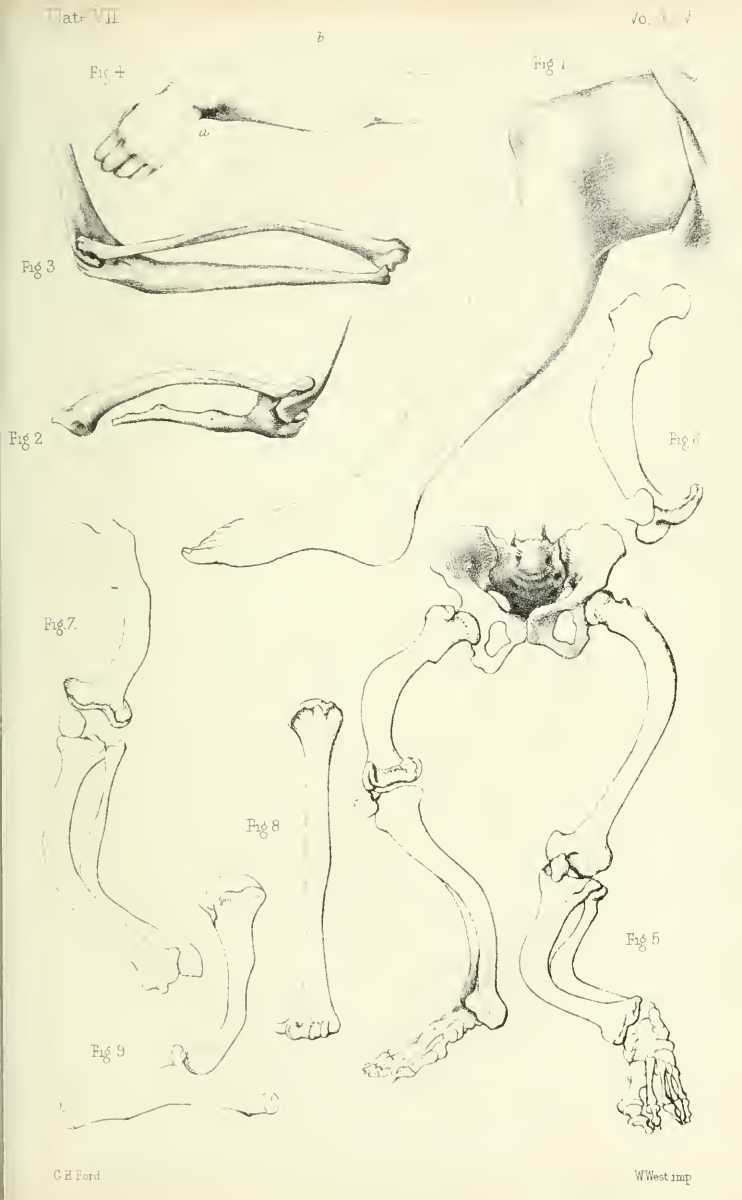
Fig. 6.—Rickety thigh-bone, bent in the upper part of the shaft, with spreading out of the lower end and bulging at the epiphysial line. From Musée Dupuytren.

Fig. 7.—Rickety thigh- and leg-bones, from Musée Dupuytren (Table III, No. 20). The lower end of the thigh-bone is spread out, and the epiphysial line very projecting and nodulated.

Fig. 8.—Short humerus, with upper epiphysial line projecting and nodulated (Table III, No. 9). From Musée Dupuytren.

Fig. 9.—Short and rickety humerus and radius. The upper part of the humerus is very thick, and the epiphysial line is prominent and tuberculated (Table III, No. 45). From the museum of the College of Surgeons.





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AN

ANALYSIS OF 230 CASES

OF

LITHOTOMY.

BY

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Received March 8th.—Read April 22nd, 1862.

I PROPOSE on the present occasion to bring before the notice of the Society an analysis of all the cases of lithotomy which can be collected from the records of Guy's Hospital of the last twenty-five years, my own notes supplying me with the information for the last eight.

I have been enabled to tabulate 230 cases, and will at once proceed to note such points as their analysis may yield.

TABLE I.—*Containing an analysis of 230 cases of Lithotomy, showing the frequency of its occurrence and mortality at different ages.*

Age of patients operated upon.	Number of cases.	Frequency of occurrence, in per-centages.		Recoveries.	Deaths.	Per-centage fatal.	Proportion fatal.		Number of cases.	Fatal.	Proportion.
2 years . .	6	2·60		5	1	16·66	1 in 6	Under 10 years of age	129	6	1 in 21½
3 „ . . .	21	9·13	73 cases, or 31·7 per cent.	21	—	—	—	*Med. T. & G.*	109	8	1 in 13⅝
4 „ . . .	23	10·00		23	—	—	—	Under 15 years of age	160	8	1 in 20
5 „ . . .	23	10·00	Under 10 years of age, 129 cases, or 56 per cent.	21	2	4·34	1 in 11½	*Med. T. & G.*	130	14	1 in 9⅔
Between 5 and 10 years	56	24·34		53	3	5·34	1 in 18½	—	—	—	—
„ 10 „ 15 „	31	13·47	—	29	2	6·45	1 in 15½	—	—	—	—
„ 15 „ 20 „	18	7·82	38 cases, or 16·5 per cent.	15	3	16·66	1 in 6	Between 15 & 40 years of age.	38	6	1 in 6⅓
„ 20 „ 30 „	13	5·65		11	2	15·38	1 in 6½	*Med. T. & G.*	23	5	1 in 4⅗
„ 30 „ 40 „	7	3·04		6	1	14·28	1 in 7				
„ 40 „ 50 „	7	3·04	32 cases, or 13·9 per cent.	3	4	57·14	1 in 1¾	—	—	—	—
„ 50 „ 60 „	19	8·26		8	11	57·89	1 in 1 11/19	Above 40 years of age	32	19	1 in 1¾
„ 60 „ 70 „	5	2·17		2	3	60·00	1 in 1⅔	*Med. T. & G.*	33	21	1 in 1⅗
„ 70 „ 80 „	1	·43		—	1	100·00	1 in 1				
	230	99·95		197	33	14·34	1 in 7				

Analysis of Table I.

Frequency of the operation of Lithotomy at the different periods of life.

The first point which attracts our attention in the table before us is the well-recognised fact of the greater frequency of calculous disease in early life; nearly one third of the whole number of cases occurred in children under five years of age, and about one fourth between five and ten years of age; more than half, or 56 per cent. of all the cases, having taken place in children during the first ten years of life.

This truth is one which has never yet received a fair explanation. That the existence of a calculus depends upon a low condition of the child's health hardly bears proof, for it is unquestionably true that the healthiest-looking and apparently best-nourished children admitted into a London hospital are those suffering with stone. Some few of the cases may owe their healthy aspect to the fact that they have been living in the country, and thus, to a London eye, may appear, by comparison, more fat and ruddy than their London fellow-sufferers; but it must be added that by far the majority of the cases occurred in London children, and thus this explanation will not suffice.

It is not, therefore, an unfair assertion to make, that in young life stone in the bladder does not appear to be a disease of debility, but, on the contrary, to belong to a condition of body which is not far from sound health.

The next point indicated by the table appears to be, that *in every succeeding period of five or ten years after ten years of age the presence of a stone becomes more rare.*

Between the ages of ten and fifteen it is about half as frequent as in the preceding quinquennial period, and this number may be again halved when the frequency of its occurrence is observed between the ages of fifteen and twenty. In middle adult life lithotomy is not an operation of frequent occurrence, but in old age it would

appear to be called for rather more frequently. The causes of this difference in adult life it is not difficult to understand, the greater frequency of lithotrity in middle age being the chief.

The mortality after the operation.

The next point in the analysis is the mortality of the operation, and on this subject considerable variation is found at different ages. In analysing my own table I propose to compare it with a second, which is not only the most recent, but which is stated to include the general experience of the London hospitals for three and a half years. I allude to that published in the 'Medical Times and Gazette,' on January 8th, 1859.

With five exceptions, the whole of these cases have been operated upon by the lateral method. In four of the five the median operation was performed, one of which died. In one the stone was extracted through the rectum.

Mortality of the operation at different periods of life.

It will be observed that the operation is most successful during the first ten years of life; indeed, it would be difficult to point to any other capital operation in which like success can be recorded. My own table gives but 4·6 per cent. of fatal cases, or 1 in every 21½. In the table from the 'Medical Times and Gazette' the mortality during these ten years is nearly twice as great, 1 in 13·6 having died. The difference between these two tables in this respect is very great, and is unaccountable.

Upon analysing the cases under ten years of age a little further, it will be seen that at the age of two years 6 cases are recorded, one of which died, but the cause of death was subsequently clearly shown by post-mortem examination to have been acute bronchitis, and was therefore unconnected with the operation.

At the ages of three and four, 44 cases are recorded, but amongst them there is not one fatal instance; those ages must, therefore, be regarded as the most favorable for operation. Between the ages of five and ten, 79 cases are tabulated, 5 of which proved fatal, or about 1 in every 16 operated upon. But if the causes of death are carefully looked for in those 5 cases, the apparent dangers of the operation are much diminished. In 2 cases, aged respectively four and a half and five years, hæmorrhage was the assigned cause of death: in both, however, there had been distinct evidence of the presence of a calculus for at least two years, or nearly half the children's lives, and no post-mortem examination was obtained to reveal the condition of the viscera, and therefore the true causes of death. In 2 cases, aged nine and ten years, in both of which the symptoms of stone had existed from birth, a necropsy revealed extensive and old renal disease. In the last case pelvic cellulitis was proved to have been the cause of death, occasioned by some accident in the operation.

It would thus appear that in children under ten years of age the dangers of the operation are very slight, particularly if the symptoms of stone have not been of long standing; for if the symptoms have not existed for a lengthened period, there is good reason to believe that the kidneys are sound, and if so, the risks of the operation are very slight. If, on the other hand, there has been evidence of the presence of a calculus for some years, or for a large portion of the child's life, renal disease may be suspected, and the danger to life by an operation will consequently be much magnified.

Passing on to the next decennial period, including those operated upon between the ages of ten and twenty, I find 49 cases tabulated, and 5 of these proved fatal, or 10 per cent. On referring to the table in the 'Medical Times and Gazette,' the mortality at these ages is stated to be 21 per cent., being more than twice as great. When we divide these cases again, it will be observed that between the ages of ten and fifteen, that is, *before the period at which*

the genital organs are fairly developed, the mortality is considerably less: 31 cases are recorded, but 2 only died, being 6·4 per cent., or 1 in every $15\frac{1}{2}$ cases; whereas between the ages of fifteen and twenty, that is, *at the period in which those parts have arrived at maturity*, the mortality is more than twice as great; for out of 18 cases 3 died, or 16·6 per cent., or 1 in every 6. This fact is very apparent and important, the risk of the operation being three times as great at this period of life as during the former quinquennial period. But if the causes of death are referred to, the special dangers of the operation are again found to diminish. For it will be seen that in the two cases tabulated as fatal between the ages of ten and fifteen, aged respectively fourteen and fifteen, the symptoms of stone had existed in the former ten years, and in the latter from birth, or as long as could be remembered. In the first case, peritonitis was the assigned cause of death, but no post-mortem examination revealed the fact; in the second, peritonitis was subsequently detected, associated with extensive renal disorganization. In both cases, therefore, it does not appear to be unfair to believe that diseased viscera existed, and that death was due to such complications, and not to any special dangers of the operation.

As to the causes of death of the three fatal cases, out of the eighteen in which lithotomy was performed between the ages of fifteen and twenty, inquiry shows that, in the first, aged eighteen, marked symptoms of stone had been present for three years, and extensive disease of the kidney was subsequently found; in the second, aged nineteen, the symptoms had existed from birth, and the same complication was revealed after death; and in the third, aged twenty, the calculus had given rise to symptoms for eleven years, and haemorrhage was the assigned cause of death, but no post-mortem examination was subsequently made. In two of these three examples it is positively proved that diseased kidneys were the real cause of death: in the third case, therefore, it is not an unfair supposition to presume that a similar cause existed, this renal disease being tolerably

clearly indicated by the fact that symptoms of stone had been manifested for a long period in each instance.

On continuing the analysis and noting the results of the operation in patients of mature age, it will be seen that the mortality during young adult life and middle age, that is, up to the age of forty, is fixed at about 15 per cent., one patient in every six and a half dying after the operation. It is true that this mortality is three times as great as it is in early life, but still it is not so high as in other severe operations, such as amputation, taking the cases as a whole.

On comparing my own table with that of the 'Medical Times and Gazette,' the comparison is still in my favour; the former yielding a mortality of 15 per cent., the latter of 21 per cent., or one third more.

If we pass on to note the mortality of the operation in patients beyond forty years of age, a very marked difference must be again recorded.

In the earlier periods of life it has been already shown that lithotomy proved fatal in only 5 per cent., or one case in twenty. In young adult life, starting from that period at which the genital organs had become parts of importance, the mortality suddenly became three times as great, or 15 per cent. In the next epoch, or in that after forty years of age, this sudden increase becomes still more apparent, the mortality of the operation rising from 15, to 57 or 58 per cent., nearly four times as great.

The average of the 'Medical Times and Gazette' is about 63 per cent. Looking for the causes of death in the nineteen cases which proved fatal in patients above forty years of age, a striking fact again comes before us; in ten of them a post-mortem examination was subsequently made, and *in all* extensive renal disease was readily detected.

Five of the remaining cases sank after the operation; three died with symptoms of peritonitis and pelvic cellulitis; one had acute cystitis. In all of these cases there had been evidence of calculous disease of some years' duration.

Review of the cases as a whole.

The most prominent point which attracts attention is the great difference in the mortality of the operation of lithotomy at the different periods of life.

In early life it is unquestionably a very satisfactory operation, if not the most successful which can be performed. In young adult life, up to forty years of age, the facts, as already stated, are by no means bad. It is true that about one case in every six and a half dies; but when it is remembered that it is at such a period of life that lithotrity is generally practised, and that, therefore, the worst cases only are lithotomized, the result cannot be regarded as indifferent.

In old age, or after fifty years of life, the operation cannot be looked upon with satisfaction, more than half, or 60 per cent., dying. The cause of death in the majority of these cases has been clearly shown to have been renal disease; and if this complication is a fatal one after most operations, it is palpably of greater importance in that which we are now considering.

In the previous pages it has been pointed out how fatal such disease has been found, and it may be safely asserted that from the earliest to the latest periods of life the risks of lithotomy are exactly commensurate with the extent of disease in the renal organs. Thus, in young life, when it is by no means of common occurrence, a good result, as a rule, takes place; but at a later period, when its presence is more frequent, a bad result has too commonly to be recorded.

The gauge of the extent of the renal disease has also been tolerably clearly indicated, the duration of the symptoms appearing to be a correct guide to aid us in arriving at the result. The analysis has shown that in early life, when death followed the operation, renal disease was observed in every case in which a post-mortem examination was subsequently made, and from similarity of symptoms it does not appear to be improbable that like complications existed

in the remainder. For it is certainly a striking fact that in seventeen out of the nineteen necropsies extensive renal disease was observed, and in the remaining two acute bronchitis and an accidental complication were the cause of death; and if the condition of the "unseen" can be diagnosed by the "seen," the presumption that renal disease was the cause of death in the majority of fatal instances does not appear to be unfair.

But to make this point more clear the two following tables may prove of value, the first containing an analysis of the cases examined after death, the second containing those in which no post-mortem examination could be obtained, with their assigned causes of death.

TABLE II.—*Showing the causes of death, as proved by post-mortem examination; the ages of the patients being also given, with the duration of the symptoms.*

Case.	Age.	Cause of death.	Duration of symptoms.
1	2	Acute bronchitis	
2	6	Pelvic cellulitis, the result of an accident	
3	9	Peritonitis and pelvic cellulitis. Diseased kidneys	From birth.
4	10	Ditto ditto Ditto	Ditto.
5	15	Ditto ditto Ditto	Ditto.
6	18	Ditto ditto Ditto	Ditto.
7	19	Ditto ditto Ditto	Ditto.
8	24	Diseased kidneys	Many years.
9	29	Ditto	Ditto.
10	38	Ditto	Ditto.
11	43	Diarrhœa. Diseased kidneys	10 years.
12	54	Pyæmia. Diseased kidneys	3 years.
13	56	Diseased kidneys	3 years.
14	58	Peritonitis and pelvic cellulitis. Diseased kidneys	8 years.
15	59	Inflammation of whole urinary passage. Diseased kidneys	6 years.
16	59	Peritonitis and pelvic cellulitis. Diseased kidneys	6 years.
17	65	Ditto ditto Ditto	6 years.
18	68	Ditto ditto Ditto	2 years.
19	70	Ditto ditto Ditto	3 years.

Analysis of Table II.

In seventeen of the nineteen cases it must be observed that disease of the kidney, in different degrees of severity, existed, and that this disease was of no doubtful nature, suppuration and degeneration being present in nearly all.

In nine of these cases peritonitis and pelvic cellulitis were also present.

In two, pyæmia was an associated cause.

In one, extreme inflammation of the urinary passages.

And in five instances renal disease was sufficient to destroy.

Table III.—*Showing the assigned causes of death, not proved by post-mortem examination.*

Case.	Age.	Assigned cause of death.	Duration of Symptoms.
1	4½	Died from hæmorrhage	3 years.
2	5	Ditto	8 years.
3	20	Ditto	12 years.
4	14	Died from peritonitis and pelvic cellulitis	10 years.
5	51	Ditto	6 years.
6	32	Ditto	18 years.
7	54	Ditto	3 years.
8	41	Sunk after the operation	Many years.
9	42	Ditto	Ditto.
10	49	Ditto	5 years.
11	54	Ditto	2 years.
12	72	Ditto	5 years.
13	57	Acute cystitis	12 years.
14	57	Pyæmia after wound had healed	4 years.

From Table II it appears to be clearly shown that, in seventeen instances out of the nineteen in which any definite information was obtained concerning the causes of death, the fatal result might, in all fairness, be ascribed to diseased kidneys, with or without any other complications. This visceral disease has been shown to have existed in the young and in the old, and, eliminating accidents, it appears to be the chief cause of death.

The fact that peritonitis and pelvic cellulitis were present in a large proportion of the cases examined need be no argument against this view, for physicians and surgeons are all well aware of the intimate connection which exists between renal disease and inflammation of the serous membranes. In medical practice this form of inflammation is, as a rule, the immediate cause of death in most examples of Bright's disease; it does not, therefore, appear irrational to doubt whether so many patients, either young or old, would sink with peritonitis and pelvic cellulitis after the operation of lithotomy, if they had not been rendered prone to such inflammation by the presence of a renal affection.

This doubt is much strengthened by the facts, that in children the operation of lithotomy is undeniably successful, and that in early life renal disease is not common. At the same time it has been shown that when death takes place, even in children, renal disease is a frequent cause of it.

From the second table somewhat similar conclusions may not unfairly be deduced: in each of the fatal cases tabulated under puberty symptoms had existed for nearly two thirds of life, and, as a consequence, diseased kidneys in all probability were present, and were the cause of death.

In the older subjects, also, like explanations of the mortality appear to be supported.

As a practical conclusion, the preceding analysis leads us with some confidence to assert—

That the dangers of lithotomy, as an operation, independently of accidents, are not great, and that a fatal result from them alone rarely takes place.

That, when death follows the operation, renal disease is the cause in almost all cases, and that this renal affection appears to follow necessarily upon the long existence of the calculus.

That the duration of the symptoms is the best and surest guide to the diagnosis of this complication, and that in pro-

portion to the period of their existence is a renal affection, as well as its extent, to be suspected, and, as a result, is the danger of the operation to be dreaded.

The early detection of a calculus becomes, therefore, an important point, and its early removal a necessity.

The prognosis after the operation rests also upon the same grounds. The shorter the duration of the symptoms the more favorable may it be; and, on the contrary, the longer they have existed it must be the more cautious.

The operation may be justifiable in all instances, but it must be undertaken with two distinct objects. In one case it would be performed with the idea and fair certainty of a cure; in the other it would be done solely with the laudable intention of giving relief, and thus of rendering the patient's last days more comfortable.

In conclusion, I may refer to the smaller mortality recorded in my table than that of the 'Medical Times and Gazette.' It is impossible to assign any definite cause for this, but, amongst others, perhaps the advocates of the use of the *straight staff* might not unfairly consider the fact a strong argument in their favour.

There is one other point also which the analysis of the cases in the 'Medical Times and Gazette' makes of interest. The editor shows that there are about forty cases of lithotomy a year in the London hospitals. At Guy's my own notes prove that the average for the last eight years has been fifteen, this figure representing more than one third of the whole number of cases operated upon in London each year, or 37·5 per cent. In St. Bartholomew's Hospital the number of cases operated upon in 1860 was ten. In St. Thomas's the average is given to us as eight.

Dr. Marcet, in his work 'On Calculous Disorders,' published forty years ago, shows that in St. Bartholomew's Hospital, at that period, the average number of cases for five years was eleven a year. In St. Thomas's it was five and a half, and Mr. South's more recent statistics confirm

the fact. In Guy's, when a little more than half its present size, the average was then given as nine or ten.

These facts tend to show that stone cases are not rarer in London hospitals than they were, and to dispel the idea that, from the freedom with which they are treated in the provinces, the metropolitan institutions will be deprived of their lithotomy practice. It may be that calculous disorders are increasing, but it is more probable that a larger number of such cases are detected, and consequently treated.

Postscript.

July 19th, 1862.

Table IV.—*Showing the apparent influence of chloroform upon the mortality of Lithotomy.*

Cases in which chloroform *was* given.					Cases in which it was *not*.			
Ages.	Number.	Cured.	Died.	Per-centage.	Number.	Cured.	Died.	Per-centage.
5 years of age and under	40	38	2	5·	31	30	1	3·33
6 years and 10 inclusive	38	35	3	7·8 } 6·1	21	21	—	— } 3·1
11 „ 15 „	19	18	1	5·2	11	10	1	9·09
16 „ 20 „	10	7	3	30·	8	8	—	
21 „ 30 „	5	3	2	40· } 35·2	8	8	—	
31 „ 40 „	2	1	1	50·	5	5	—	
41 „ 50 „	4	2	2	50·	3	1	2	66·66
51 „ 60 „	9	3	6	66· } 62·5	10	5	5	50·
61 „ 70 „	3	1	2	66·	2	1	1	50· } 56·2
71 „ 80 „	—	—	—	—	1	—	1	100·
	130	108	22	16·9	100	89	11	11·

The weight of evidence afforded by this table, taking the numbers as a whole, apparently tends against the administration of chloroform. The mortality of the operation of lithotomy without the use of the anæsthetic was 11 per cent., and with it 16·9 per cent.; the difference between the two classes of cases was, therefore, 3·9 per cent., the use of chloroform raising the mortality 50 per cent.

The conclusion to be deduced from these figures is somewhat startling, and it is difficult to believe that it can be correct. An inquiry into the causes of death of the two classes has failed to give any satisfactory solution of the difficulty, and as facts are wanting, theory may be justifiable.

A partial explanation of this apparent difference is, I believe, to be found in the fact that, since the introduction of chloroform, surgeons have been induced to submit patients to the operation of lithotomy, for the purpose of removing a source of irritation and of relieving pain, more frequently than they were in the habit of doing before the use of the anæsthetic had become known; and that by this practice a bad and necessarily fatal class of cases has been admitted into one part of the table which is excluded from the other.

This change of practice I take to be nearly sufficient of itself to account for the difference; but as an additional explanation of the discrepancy, the following does not appear to be unfair.

In the body of my paper I have shown how fatal renal disease has always been as a complication of lithotomy, and it can hardly be denied that chloroform, in common with all stimulants, has a powerful effect upon the kidneys. If these organs are sound, no evil will be experienced from its use; but if inflamed or diseased, a bad effect must be produced. It does not appear, therefore, to be improbable that it is by this stimulating effect upon a diseased organ that the increased mortality of the operation of lithotomy under the influence of chloroform may be partially explained.

A patient with extensive renal disease, subjected to lithotomy, will certainly sink, whether chloroform be employed

or not; but there is probably a degree of renal disease which, though not of itself sufficient to destroy, may yet, under the evil influence of a powerful stimulant such as chloroform, be aggravated into importance, and prove dangerous to life. The use of the anæsthetic in these doubtful cases may weigh down the finely suspended balance of life and death, and by stimulating inflamed and diseased kidneys, expedite a fatal result.

ON THE TREATMENT

OF

ACUTE RHEUMATISM,

CONSIDERED WITH REGARD TO THE LIABILITY TO AFFECTIONS OF THE HEART UNDER DIFFERENT REMEDIES.[1]

BY

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Received April 9th.—Read June 10th, 1862.

The author of the paper about to be laid before this Society has, for several years, held the office of Medical Registrar, which made it necessary for him to watch cases of disease which, although of a similar nature, have fallen under the care of different physicians, and have consequently been subjected to diverse methods of treatment. A general conviction soon arose in his mind, which was shared by others who frequented the medical wards of the hospital, that the frequency with which acute rheumatism was followed by inflammatory affections of the heart, was regulated by the treatment to which the patients were subjected. The inquiry, of which the results are here given, was undertaken with the purpose of examining, in a rigid and impartial manner, the experience which has been accumulated during a certain term of years, as to the effects of medicine in this

[1] The paper was accompanied by an elaborate tabular analysis of the cases, which the Council of the Society, however, were not able to publish. —*Sec.*

disorder. The cardiac complications, as they are immeasurably more important in the long run than the severity or duration of the pain, have been regarded as the first object of the investigation. The author has no theories of his own to recommend. He can claim no credit beyond that due to an impartial observer and an honest chronicler of facts brought out by the experience of others.

The tables which are given extend over the five years beginning with the 1st of January, 1857, and ending with the last of December, 1861. They include those cases of acute rheumatism, which came in during that period, in which, on admission, the sounds of the heart were natural. These have been classified according to the treatment adopted, and the condition of the heart has been noted throughout. A few only have been omitted, of which the existing notes were too imperfect to afford a trustworthy result. The author has to thank Dr. Page, Dr. Bence Jones, Dr. Pitman, and Dr. Fuller, the physicians of the institution during the period selected, for placing their own case-books at his command, without condition or limitation. The freest use has been made of the permission thus liberally accorded, beside which the author has been able to refer to his own notes of the cases, extending over about half the time. The inquiry has been followed without any prejudice in favour of one plan rather than another. As the cases have been treated purely with a desire to benefit the patients, without any view to the deduction of therapeutical principles, the classification proved a much more complicated matter than if each patient had been regarded as a subject for a definite clinical experiment.

Every case presented on admission, or on the commencement of the treatment, the well-marked symptoms of acute rheumatism. This is stated at the outset, in order that much repetition may be avoided. It is also needful to state that in every case recorded there was clear evidence by auscultation that the heart and its membranes were as yet unaffected by the disease. As it has been the main object of the investigation to ascertain the effect of remedies in pre-

venting cardiac complications, the arrangement has not been influenced by treatment adopted in consequence of their occurrence.

Venesection.

The first table gave the results of eight cases, no doubt all severe, in which bloodletting was early resorted to. In each of them other remedies were also used. In all but one calomel and opium were given at intervals, and, for the most part, saline medicines as well. In three of these cases the heart became affected with endocarditis or pericarditis, in a decided manner. In one there was incomplete evidence of cardiac derangement. The heart therefore remained uninjured in only half the number. The cases remained in the hospital for periods varying from thirteen to eighty-four days, giving an average, under treatment, of rather more than forty-one days.

It would be easy to collect from various sources cases which would show that the liability to affections of the heart is certainly not lessened by venesection. Bouillaud, who is the great advocate of this method of treatment, and trusted to it almost exclusively, expresses an opinion that such complications are the rule, and not the exception.

Mercury.

The second table gave the result of six cases where the cure of the disease was entrusted almost entirely to repeated doses of calomel and opium, while in Tables 5 and 6 were seen the effects of the same medicines, aided by saline draughts, with and without nitre. The progress of the disease appears under each plan to be much the same. The three tables, giving together twenty-four cases subjected to mercurial treatment, afforded six examples of inflammation of the heart or its membranes, two of which proved speedily fatal. The patients who left the hospital alive remained under treatment, on an average, for thirty-seven days.

Remedies supposed to exert a specific action in acute rheumatism, excluding alkalies and their salts, with the vegetable acids.

The third table included fourteen cases which resemble each other more as regards the absence of the more ordinary methods of treatment than by the uniformity of the remedies used. Nitrate of potash was given in half the number, with results which will be shortly considered. Dover's powder, opium, belladonna, quinine, iodide of potassium and guaiacum were used in the remaining seven. The general result of these latter remedies may be stated as peculiarly unsatisfactory. The heart became involved in four of the number, and the duration of the treatment gave a mean of rather more than forty-six days.

These numbers are worthless as regards the merits of any individual remedy, but they may have their weight as compared with the results of the medicines which are here excluded.

As to the frequency of endocarditis after the treatment of opium, which is here only represented by one case, important information has been given by Dr. Sibson, in some tables published in the 'Association Medical Journal.' Twenty-one cases are here recorded, in which, when the treatment was commenced, the sounds of the heart were natural. Opium was administered in frequent doses, sometimes as much as a grain every hour, conjoined with other remedies reputed to have an effect in rheumatism. No less than fourteen of these cases—exactly two thirds—manifested while under treatment the symptoms of valvular or pericardial inflammation.

Independently of any direct evidence, it surely might have been inferred that opium would prove highly injurious in this disorder. It is known to impede the action of the great excreting organs within the abdomen—the bowels, the liver, and the kidneys. Much of the rheumatic virus which would ordinarily escape by these channels must therefore be retained in the system, at the risk of the structures most amenable to its influence.

Nitre.

The seven cases treated with nitre, without salines, alkalies, or mercury, give only one example of cardiac complication, and afford the unusually low average of twenty-seven days for the duration of the treatment. These few cases, then, speak well on both grounds for the action of the remedy. The same deduction may be drawn by comparing the cases treated with nitre in conjunction with saline remedies with those which had salines alone, or salines with so-called specific medicines, excluding nitre. The addition of the nitrate of potass thus appears to occasion better results, both as regards the duration of the disorder and the immunity of the heart, than follow the draughts from which nitre has been excluded.

Dr. Basham, in a paper printed in the 'Transactions of the Medical and Chirurgical Society,' has given the results of the treatment by large doses of nitre, assisted, however, by other remedies. His table gives sixty-seven cases where, on the commencement of the treatment, the heart was unaffected. In only six of these, a proportion of about one in eleven, did that organ become involved during the progress of the disease. The duration of the disease was not very different from what was observed in the cases here given.

Salines.

The difficulties which attend any classification which is founded upon the treatment adopted by different persons, in any disorder, make it necessary to limit the meaning of the terms used.

The term "saline" has been necessarily applied in a somewhat arbitrary sense. It has been used, however, with a precise and definite signification, which may be held to excuse the perversion of the word.

It appears that the salts which potass and soda form with the vegetable acids undergo such changes in the system as to become equivalent to the same, or nearly the same, quantities of the alkalies in combination with carbonic acid. Thus,

whether a certain quantity of potass is administered as citrate, tartrate, acetate or carbonate, much the same effect is produced upon the urine, and, it may be presumed, upon the system generally.

This axiom has been made the basis of the arrangement. All those patients who were treated with an aggregate quantity of such salts (potass and soda with carbonic and the vegetable acids) not reaching three drachms in the twenty-four hours have been considered as under *Saline treatment*. In this sense only has the term been used.

Those cases which were treated with these salts in quantities together amounting to three drachms, but falling short of half an ounce in the same period, have been characterised as under *Partial alkaline treatment*.

The table headed "Full alkaline treatment" was made to include patients taking in the twenty-four hours from half an ounce to an ounce and a half of the same medicines.

Sixty-two cases were subjected to the so-termed saline treatment. In by far the greater number of these other remedies were given in conjunction, and the tribe was broken up into families according to the particular medicines thus interposed.

The whole number gave seventeen instances of cardiac complication; a proportion of 1 in 3·6.

The general conclusion appears to be that saline remedies are ineffectual, either for the shortening of the disease or the protection of the organ chiefly endangered.

In the cases where the method has been used single-handed, the results are about intermediate between the successful and the unfortunate—seven cases afforded two examples of the inflammation of the heart, and remained under treatment, on an average, thirty-three days.

Saline medicines with nitre give somewhat better results in both particulars, but are not so successful on either ground as where nitre has been used alone.

Salines with repeated doses of calomel give a longer duration to the disease than follows the use of mercury alone, although as regards the liability to affections of the

heart the additions of the salts appears to work no alteration.

Salines with reputed specific remedies partake of the ill success which follow the latter medicines when used by themselves. Of six cases where Dover's powder was thus resorted to, the heart became involved in four. This closely corresponds with the disastrous results already shown to attend the use of opium.

It thus appears that the saline treatment has by itself little influence upon the course of the disorder. When it has been used in conjunction with more potent measures, the result has corresponded with the observed effect of the additional remedies when used independently.

Partial alkaline treatment.

When the doses of alkaline and decomposable salts have been increased to between three and four drachms a day, and these given without other remedies, though they do not lessen the frequency of the heart symptoms, yet they appear to lead the disorder to a more speedy termination. No such advantage, however, appears when the treatment is complicated by the addition of colchicum and other medicines.

In the total of seventeen cases the heart became affected in six, which is a rather larger proportion than appeared with the smaller doses of salts.

Full alkaline treatment.

The treatment thus described consisted in the daily administration of salts, such as have been already specified, in quantities which varied from half an ounce to an ounce and a half. Half a drachm of the acetate, with a drachm or a drachm and a half of bicarbonate of potass, dissolved in the Haustus Ammoniæ Acetatis of the hospital pharmacopœia,[1] furnished a very ordinary form of prescription.

[1] This consisted of half an ounce of the Liq. Amm. Acetatis with an ounce of water.

This was given every four or six hours. Sometimes the medicine was made to effervesce by the addition of a little citric acid.

Salts of soda, the bicarbonate and potassio-tartrate, were resorted to in some of the cases.

Twenty-two cases thus treated yield a better result, as regards the duration of the disorder, than belongs to any other method. The number of days in the hospital is reduced to an average of twenty-five.

When the simplicity of the method has been departed from, the superiority as regards the shortening of the rheumatism becomes less striking. Twenty-six cases where the alkalies were given, with the addition, mostly, of colchicum, give an average duration to the disease exceeding by five days that obtained by the more simple plan.

It may be remarked, too, that where colchicum was used in aid of the partial alkaline treatment, the patients remained longer in the hospital than where the same system had been pursued without any such addition. It may, therefore, be concluded that, although this remedy appears to exert no especial influence upon the heart, yet it rather hinders than accelerates the cure of the rheumatism.

The great fact, however, which may be deduced from this investigation is unaffected by this incidental remark.

The total of forty-eight patients subjected to large doses of alkaline salts passed through the dangers of the disease with only a single instance of any cardiac affection. In this one exceptional case the sounds of the heart were noted as free from murmur on the day of admission. The stethoscope was not again applied until twenty-four hours afterwards, when a valvular murmur was heard. This was followed by a feeble friction sound. Ten days later, however, the sounds were again normal, and they so remained until the patient left the hospital.

A certain time must, of course, elapse before remedies taken into the stomach can affect the system generally. The occurrence, therefore, of this case cannot be held to weaken the conclusion which must be drawn from the forty-

seven other cases, in which the protection extended to the heart was complete.

The importance of this fact is such that it can scarcely be overrated.

Dr. Garrod, in a paper printed in the 'Transactions' of this Society for 1855, has recorded the results of the treatment of the disorder by bicarbonate of potass, as observed at University College Hospital.

This was given in frequent doses, amounting generally to an ounce daily. Twenty-four cases, in which, on the commencement of the treatment, the heart was unaffected, afforded three instances of rheumatic inflammation of the organ. This came on, in each case, before the medicine had been taken for forty-eight hours.

This result is not quite so satisfactory as has been obtained at St. George's, which is, perhaps, owing to the exclusive use of the alkaline carbonate. Nevertheless it must be regarded as a great success when compared with any different method of treating the disease.

The conclusion, then, must remain unshaken, that the carbonates of potass and soda, with those of their other salts which in the body must be presumed to be converted into the carbonates, exert an especial curative power over rheumatic fever, and if given in time, will completely protect the heart from the dangers by which it is surrounded. It is worth remarking, in connection with this subject, that, contrary to what would have been expected, no part of the protection which is afforded by full doses of alkali or of decomposable salts appears to be afforded by quantities which fall short of a certain definite amount. As far as the heart is concerned, "partial alkaline treatment" is useless.

Possibly the salts of ammonia may exert a similar influence to those of potass and soda, but as yet there is not sufficient evidence to lead to any conclusion.

Taking the proportion of heart affection under the alkaline system, 1 in 48, or including those treated with ammonia, 1 in 53, and, with this as a standard, reviewing the other plans of treatment, the result is sufficiently striking.

113 cases where other remedies were used give 35 instances of cardiac mischief, or a proportion of 1 in 3·2.

Nitre, next to the alkalies, is the most successful. It appears not only to shorten the disease, but to extend a limited protection to the heart. It reduces the frequency of cardiac inflammation to about one case in ten. On reviewing the action of the other remedies which have been credited with the cure of acute rheumatism, it simply becomes a question which is useless and which is injurious.

Mercury allows a proportion of cardiac inflammation of one case in four; saline medicines give in this particular a rather worse result. With bleeding, one half of the cases become thus complicated. Under opium the mischievous influence of the disease appears to attain its maximum. Two thirds of the cases, as it appears, manifest the symptoms of endo- or peri-carditis.

Excepting nitre and alkalies, it is scarcely possible to avoid the conclusion that the more active the treatment, and the more potent the remedies, the more untoward is the progress of the disease.

Saline medicines alone are better in effect than when mercury, colchicum, or Dover's powder, have been used as auxiliaries. When alkalies have been given, although in small quantities, a comparatively good result is manifest, which disappears when other remedies are conjoined. In the same way, full doses of alkali are robbed of some of their efficacy by the addition of vinum colchici.

It may be deduced from the mass of experience which the tables represent that acute rheumatism would be treated best by giving, at short intervals, a solution containing nitrate, acetate, and bicarbonate of potass, in such quantities that the two latter salts would together amount to, at least, an ounce in the twenty-four hours. Half a drachm of the acetate, with a drachm of the bicarbonate and ten grains of nitre, given in solution, every four hours, would fulfil all indications. At the outset of the treatment, so long as the urine remains acid, the medicine should be given in larger quantities or at shorter intervals. It must, of course, be need-

ful at the same time to pay regard to any symptoms peculiar to the individual case, especially such as show a loaded state of the bowels or defective secretion by the abdominal viscera.

It seems remarkable, with such indications as exist of a supernaturally acid state of system, that alkaline remedies were not resorted to by the older pathologists in cases of acute rheumatism. Perhaps this may be accounted for by the vague state of their chemical knowledge. Mascagni, in 1804, having observed how easily coagulable lymph could be dissolved even in a weak solution of the alkaline carbonates, was led to propose the use of those remedies in acute inflammatory diseases and in complaints of a more chronic nature, which he supposed were characterised by the effusion of the same material. The late Dr. Samuel Wright, of Birmingham, in a lecture on rheumatic fever, which was published in 1847, dwells upon the importance of correcting the acid state of the system and its secretions, stating that "the acidity is greatest where the inflammation is highest; that an increase of acidification is often a precursor of an increase of the febrile and inflammatory action; and that the correction of the former is often followed by a complete cessation of the latter." He then commends what he terms *the alkaline treatment of rheumatism*, expressly stating it to be "no novelty of practice," although he was not aware by whom first it had been recommended. The author of this paper has not been more successful in finding the earliest suggestions which preceded this important discovery. Dr. Wright states that he had, for many years, been in the habit of trusting to alkalies in this disorder, and contrasts the results obtained under their use with the inefficacy of methods more generally adopted. He was in the habit of ordering the bicarbonate of soda in comparatively small quantities from two to four drachms daily, and using in addition alkaline baths. He makes no mention of the immunity of the heart under this system. Dr. Fuller has worked out the discovery which Dr. Wright left thus imperfect, and in his work, published in 1852, claims for the alka-

line treatment, which in his hands was more boldly applied, the invaluable peculiarity which it possesses. The method thus advocated was further tested by Dr. Garrod, and the results brought forward in 1855 in the paper of which mention has already been made.

When it is considered how large a proportion of the multitudes who die every year from valvular disease of the heart, owe their fate to the progressive mischief initiated by rheumatic fever, we may appreciate the importance to humanity of any discovery by which this fatal alliance is forbidden.

Abstract of Tables, including 164 *Cases.*

Number of table.	Treatment.	Number of cases so treated.	Cases in which heart became affected.	Average number of days in hospital.	Cases which ended fatally.
1	Venesection, with other remedies	8	4	41	0
2	Mercury	6	2	29	0
3	Nitre	7	1	27	0
—	Repeated specifics (including guaiacum, Dover's powder, opium, iodide of potassium, and quinine)	7	4	46	0
4	Salines (less than ʒiij of salts daily)	7	2	33	0
5	Salines with nitre	28	6	32	0
6	Salines with nitre and mercury	7	1	36	1
7	Salines with mercury	11	3	43	1
8	Salines with specifics	9	5	35	0
9	Partial alkaline (less than ʒiv of salts daily)	8	3	28	0
10	Partial alkaline, with other medicines	9	3	40	0
11	Full alkaline (more than ʒiv daily)	22	1	25	0
12	Full alkaline, with other medicines	26	0	30	0
13	Salts of ammonia	3	0	22	0
14	Incapable of classification	6	1	65	0

AMAUROSIS

CONSEQUENT ON

ACUTE "ABSCESS" OF THE ANTRUM, PRODUCED BY A CARIOUS TOOTH.

BY

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Received April 22nd.—Read June 24th, 1862.

The particulars of the case I am about to detail are so important and so very exceptional, that I have thought I might venture to call the attention of the Royal Medical and Chirurgical Society to a single instance of disease, whose very singularity does not allow this communication to assume that general and extended character which is customary in papers read before the meetings of the Society.

I have only succeeded in discovering one recorded case at all analogous to that which is the subject of this memoir, in which abscess of the antrum occasioned by a carious tooth resulted, among other inflammatory mischief, in the destruction, as an organ of vision, of the eye of the affected side.

There is, of course, nothing unusual in the development of so-called "abscess" of the antrum from a carious tooth; such cases are of frequent occurrence, and the cause specified is by far the commonest in producing suppuration within the maxillary sinus. Moreover, occasionally, though rarely, the eyes become subject to chronic congestion from wide-spread inflammation produced by dental caries in the front of the

upper jaw. But the combination, from such a cause, of the severe symptoms which constituted the case I am now about to relate is, as far as I am aware, almost without precedent.

Eliza Foley, æt. 24, a domestic servant, had been in perfectly good health up to the 25th of April, 1860, when, without any new or special cause, she was attacked with violent pain about the remains of the first right upper molar tooth, the crown of which had been lost by caries. Enormous swelling of the side of the face came on rapidly; infiltration of the lower lid, which nearly closed the eye; protrusion of the malar bone, and a thrusting over of the nose to the opposite side. The patient describes as fearful the pain of the whole of that side of the face and the eyeball, which latter became protruded. A few hours after the occurrence of these symptoms she observed that she was quite blind in the right eye, which had hitherto been perfect in its functions. About twenty-four hours after the supervention of this great and extended swelling, matter pointed just below the inner canthus, and the general practitioner who was attending the patient evacuated it by means of a lancet-puncture. This orifice closed at once, and after the lapse of another twenty-four hours a fresh pointing of matter was observed below the outer canthus, which was evacuated in the same way. No further treatment was adopted, and the patient remained in great suffering for two or three weeks, the blindness of the right eye continuing, and the swelling and protrusion of the cheek being only mitigated by occasional discharges from the two orifices which had been punctured, sometimes at the inner, sometimes at the outer, canthus, and sometimes also by a flowing of purulent matter from the nose; but this latter did not occur till many days after the distension had been relieved by the bursting of the antrum at the corners of the eye.

At this juncture the girl was sent to Guy's Hospital, and was admitted on the 23rd of May under the care of Mr. Cock, at whose suggestion I was consulted.

The patient presented herself to me with her face covered up in a handkerchief, upon the removal of which she exhibited the most horrible disfigurement. The left side of the face was natural. The right was enormously swollen over the whole cheek, but especially about the region of the malar bone, which was protruded and tilted forwards; the lids were œdematous and closed, while from the orifice just below the outer canthus and in the lower lid streamed a profuse discharge of grumous pus. The surface here was livid-red or purplish, and the surrounding skin polished and glistening. So remarkable was the patient's appearance, that I had a water-colour drawing made of her at the time, and before any surgical interference had taken place. Upon examining the mouth I found that the second right upper bicuspid had been recently removed, and that the fangs of the first molar, whose crown had been destroyed by caries, and a carious dens sapientiæ, remained. The hard palate on the right side was full and convex into the mouth.

I determined to remove the stumps and the carious wisdom tooth. Upon applying the elevator to the former they were very readily extracted. The pressure of the instrument caused pus to pour from the orifice near the corner of the eye, and more from the right nostril, while the withdrawal of the molar fangs opened the floor of the antrum and led to an abundant purulent discharge into the mouth. The performance of this operation conveyed to my touch a perception that the whole maxilla was implicated; there was a general bogginess and a soft yielding of the entire bone; and further, the hæmorrhage which followed the extraction of the stumps, and which was rather considerable, led to blood-discharge from the cheek-fistula and nose, as well as from the tooth-socket. Upon examining the extracted fangs of the molar tooth, the two outer ones were found naked of periosteum at their extremities, having been free and bathed in pus within the antrum.

The condition of the eye of this patient constituted the most important and the most distressing of the symptoms. The sight was utterly gone; the globe prominent, rather less so

than at first, and slightly everted; there was extreme conjunctivitis both of the eye and eyelids; films of inspissated mucus covered the front of the eye; but the cornea, aqueous humour and chamber, and the iris, were nearly healthy. There was general deep inflammation of the fibrous textures of the eye. The pupil was large and rigidly fixed; it did not move in co-ordination with that of the other eye under any circumstances.

On the 7th of June, ten days after the previous report, some abatement of the inflammatory symptoms was said to have followed the extraction of the teeth; there was still very abundant discharge through the orifice on the cheek, through the nose, and into the mouth, the relative amount that escaped from the two former being determined by the position of the head; if laid on the right side, the chief flow was from the orifice in the cheek; if on the left, from the nose. The passing of a probe through the upper aperture distinctly indicated the presence of dead bone, which I had long suspected to exist.

On the following day a considerable sequestrum was removed, consisting of part of the floor of the orbit and the cheek surface of the maxilla, involving the infra-orbital foramen, and also a long, thin plate of bone from the outer wall of the nose. The bone was removed by a crescentic cut from the orifice below the outer canthus to the scar of one that had existed below the inner canthus.

The removal of this dead bone was followed by an immediate and complete cessation of all inflammatory symptoms: the integument about the eye paled down to a normal colour, and the general inflammation of the eyeball rapidly disappeared, but the eye remained sightless and the pupil still rigidly fixed.

It is unnecessary to detail the frequent reports which followed this date. The discharge continued, and was fetid, and nothing remarkable occurred till the 12th of July (five weeks after the removal of the dead bone and the cessation of the general inflammation), when, for the first time, I noticed that the pupil of the implicated eye moved in

accordance with that of the seeing eye, though vision had not returned. A small flake of bone came away at this time through the orifice made in the removal of the large sequestrum, and this aperture had now assumed a definite shape: it was oval, about the size of a horse-bean, with clean edges deeply adherent to the subjacent bone, and continuous with the mucous lining of the antrum.

I had the patient's portrait taken at this time, as contrasted with her condition during the acute stage of the case, and the artist well succeeded in portraying the vacant, meaningless stare of the sightless eyeball. During the remaining five months of the year nothing of importance occurred in the patient's condition beyond the exfoliation of six small flakes of bone (three in September and three in November), and the gradual diminution and ultimate cessation of the discharge. The affected eye remained totally blind, but the left eye had never in any way sympathised with its damaged fellow.

On the 3rd of January, 1861, the patient was discharged and was taken into the hospital as a night-nurse, so that she has continued still under observation up to the present time. The loss of vision in the affected eye has remained permanent, and the necrosis of bone below the orbit has produced a persistent opening into the antrum. Neither of the eyes has exhibited any inflammatory or textural change; the movements of the two pupils are co-ordinate; the axis of the blind eye has remained slightly everted.

On several occasions I have examined the blind eye with the ophthalmoscope; the humours are all perfectly transparent, and the retina healthy. The only abnormal appearance which this method of examination has displayed has been extreme *anæmia of the optic nerve* at its abutment on the retina. Instead of exhibiting the ordinary yellowish-pink disc, it has presented a white, circular area, characteristic of anæmia of the optic nerve, so constantly associated with suspension of the function of vision dependent upon causes external to the globe.

In making these examinations I have recently availed

myself of the assistance of my accomplished colleague, Dr. Bader, whose long-continued and extended investigations with the ophthalmoscope give great weight to his observations. The illustrations in Plate VIII, exhibiting the terminations of the optic nerves in the two eyes, were executed with the help of his horizontal ophthalmoscope, and they show in a striking manner the comparative complexion of the functional and functionless nerves. I would only remark that the outline of the optic nerve in the left—the seeing eye—a little departs from the circular form, being somewhat oval, a circumstance by no means uncommon, and probably a congenital condition.

The case I have just described is not absolutely unique; one in the most important particulars analogous to it occurred some years since in the practice of Mr. George Pollock, of St. George's Hospital, to whom I am indebted for the following summary:

A gentleman, æt. about 35, was attacked with intense, deep-seated inflammation of the superior maxillary region and orbit, more especially the latter, involving the eye in universal congestion of its tissues. The globe was protruded, the sight completely gone, and the pupil dilated and fixed under all circumstances. Upon examination Mr. Pollock found that there was much tenderness on pressure, extending downwards from the inner edge of the lower margin of the orbit towards the jaw on the affected side, and upon scrutinising the condition of the mouth, some carious teeth were found, which, for want of any other evident cause, he considered might be the origin of the existing mischief. He therefore directed that any of them which could possibly be implicated should be removed. This was done by Mr. Vasey, the Surgeon-Dentist of St. George's Hospital, who informs me that he had extracted the fangs of the first pre-molar and the first true molar teeth, and that the latter exhibited indications of great irritation about its roots. The removal of the teeth was followed by

the immediate and complete subsidence of all the inflammatory symptoms, and in about ten days all heat, redness, and apparent ophthalmic inflammation, had vanished.

The eye was sightless. At first the pupil remained as it had been during the inflammatory action, fixed and dilated; but it subsequently resumed its contractile function in co-ordination with that of the seeing eye.

I learn from Mr. Pollock that there was no "abscess" of the antrum, but there was sufficient evidence that active inflammation pervaded the whole soft structures connected with the maxillary bone.

The eye has remained to the present time (after a lapse of three or four years) perfectly natural to external appearance, though entirely blind, and its suspended function has given rise to no textural change in itself, or, by sympathy, in its fellow: the latter has been tried severely, as the patient, not long after his recovery, was exposed to great bodily exertion and physical hardship in a naval expedition.

The only published case with which I am acquainted, resembling those here described, is recorded by Dr. Brück, in Casper's 'Wochenschrift'[1] for 1851, and an abstract of it is given in the 'Annales d'Oculistique'[2] for 1856. This case, however, was much more chronic, and the loss of vision less permanent than in the others.

The patient was a healthy man, æt. 45. He had suffered for many years from chronic inflammation of the mucous membrane of the nose and maxillary sinus on the left side, with frequent acute attacks of great severity. On the occasion of the acute attacks the inflammation involved the whole maxillary bone on the affected side, the teeth, the tongue and throat, and extended up the scalp, which be-

[1] "Wiederholte Entzündungen des Antrum Highmori und Amaurose," &c. Mitgetheilt vom Dr. A. Th. Brück. In Casper's 'Wochenschrift für die gesammte heilkunde,' Berlin, März, 1851.

[2] "Amaurose coincidant avec une inflammation de l'antre d'Highmore." In 'Annales d'Oculistique,' p. 90, tome xxxvi, Bruxelles, 1856.

came intensely sensitive. There was great injection of the eyelids, the globe protruded, and there was much and severe toothache. After a few days, matter, previously pent up in the antrum, burst through the left nostril, and the patient recovered from the acute symptoms, which, however, again and again recurred.

The interesting point of this case is the relation of the affection of the eye to that of the antrum. The former appears to have followed and been dependent upon the latter. On the occasion of the acute attacks the globe was protruded, as Dr. Brück says, by the vaulting of the roof of the maxillary sinus from its distending contents, and all the structures within the orbit appear to have shared the inflammation. In an early stage of the case *vision was entirely lost and the axis of the eye diverged.*

Under treatment, the symptoms of the antral affection gradually disappeared, and with their disappearance the sight of the affected eye returned.

The function of the right eye never suffered, either intrinsically or by sympathy with its fellow, and the sight was only imperfect in calculating perspective. The general meaning of this case is sufficiently obvious, though some of its details are deficient. The fixedness or mobility of the pupil in relation to that of the other eye is not given, nor is the condition of the teeth distinctly defined, though dental caries is implied from the repeated allusions to toothache on the affected side.

Remarks.—When we consider the degree of inflammation which often attends alveolar abscess from carious teeth, it seems strange, rather than otherwise, that neighbouring parts do not suffer more often deeply and destructively. The examples I have mentioned are among the rare instances of these exceptional results.

That tooth disease, and consequent diffused inflammation among neighbouring fibrous structures, led to the eye symptoms in the first two cases I have mentioned is beyond question, and the same train of cause and consequence was,

in all probability, in operation in the last. In this third example, however, the particulars are not given with critical accuracy, and inference must fill up deficiencies of detail. The manner in which the consequences of tooth inflammation may wander to a remote region is shown in those instances where a tooth in the front of the mouth may give rise to an alveolar abscess, which will point far back in the palate. The pus in such an instance burrows among the cancelli which separate the two (nasal and palatal) layers of compact bone constituting the hard palate; and the occasional, though rare, development of osseous septa which traverse the cavity of the antrum would, by connecting the floor with the roof of the maxillary sinus, thus form a course, which might bring the inflammatory products of a suppurating periodontal membrane to the immediate region of the eye, instead of the soft palate. General and diffused inflammation of the whole maxilla, brought about by the same cause, would, however, render such an explanation unnecessary.

Neither in my own case nor in Mr. Pollock's was the loss of vision dependent upon damage done to the structures of the eye itself: when the inflammation of the globe subsided, which it did rapidly upon the removal of its exciting cause, the humours at once exhibited a perfect transparency. In my case, moreover, when the eye was examined with the ophthalmoscope, the retina itself presented no textural change which would account for the loss of vision. Again, in neither case were there any *cerebral* symptoms during any stage of the disease, so that the blindness cannot have depended on disease of the brain. These negative reasons, and all the positive circumstances of the cases, tend to show that the mischief occurred to the nerves themselves, whose functions were damaged, in their course external to the cranium and before they reached the globe. The stretching of the nerves by the protrusion of the eye may have had some temporary share in the suspension of their function; but, were this the only influence bearing on them, the blindness would probably have been

partial, and perhaps transient, as the mechanical protrusion of the globe, by tumours not involving the optic nerve, does not necessarily entail blindness; and where that does occur, the restoration of the eyeball to a tolerably natural position is usually accompanied by a return of sight.

In the case of Eliza Foley, the loss of bone from the floor of the orbit does not explain the suspension of vision, as the sequestrum came from the front of the eye-socket, and could not in any way have entangled the nerves of the eye. In all the three cases which I have given, the pathological condition (as far as the ophthalmic complications are concerned) appears to have been *a plastic inflammation*, involving the fibrous tissues which surround the nerves passing from the cranial cavity to the eye. Whether the inflammatory products had simply enclosed the nerves, and affected only their fibrous coverings—thus, as it were, strangling by pressure the softer nervous elements—or whether the plastic exudation had been intrinsic in the nerves themselves, can only be matter of speculation in the absence of anatomical observation. It is an interesting fact, both in Mr. Pollock's case and my own, that the different nerves entering the orbit have been differently affected; the optic nerve was hopelessly implicated from the first, blindness was complete and final; the third nerve was involved in the early stage of the disease, as evidenced by the temporary fixedness of the pupil, which afterwards recovered its contractile function; while the eversion of the axis of the globe showed that the sixth nerve (abducens oculi) had escaped injury or had suffered less than the third.

As regards the anæmia of the optic nerve, is its bloodlessness the result of mechanical obstruction to the circulation, or does it simply depend upon, and is it secondary to, suspended function? A circumferential plastic exudation encasing the nerve might possibly strangle by pressure the circulation within it, or an interstitial deposit of lymph between the fibrillæ might effect that consequence more readily and completely. Then, on the other hand, it is well known

that a suspension of the function of sight by causes external to the globe itself, even so remote as disease of the brain, will entail complete anæmia of the optic nerve. The precise relation, therefore, in this case, of the sightlessness of the eye and the anatomical condition in question must remain matter of doubt, but the condition itself is very pronounced and striking.

DESCRIPTION OF PLATE VIII.

Peripheral terminations of the optic nerves in the retinæ of the two eyes.

R. That of the blind eye, with anæmic optic nerve.

L. That of the left eye; optic nerve normal in colour, but irregular (oval) in outline.

R L

Ed Ford chromo W West chromo imp

TWO CASES OF EXTENSIVE

ARTERIAL OBSTRUCTION

FROM

SEPARATED CARDIAC VEGETATIONS,

FOLLOWED BY

GANGRENE OF THE LOWER EXTREMITIES AND DEATH.

BY

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In presenting the two following cases to the Society, it is not my intention to enter into the subject of arterial obstruction generally. I am quite aware that instances of plugging of arteries by so-called vegetations from the heart are not uncommon. The extent, however, to which the plugging took place, the number of vessels involved, the morbid changes in and around the walls of the vessels at the seat of obstruction, and the consequences which ensued, appear to me to give a peculiar interest to these cases, and to render them worthy of being placed on record.

Case 1.—Maria Chitton, a sempstress, æt. 30 years, was admitted into the Middlesex Hospital under my care, January 29th, 1861. She was well-formed, of middle-height, and moderately stout and muscular. She was unmarried, but had cohabited with a man for thirteen years up to about six months before her admission, when he left her. This

desertion affected her much, and she abandoned herself to a very irregular and dissolute life. She never had syphilis. Twelve years ago, when at the age of eighteen years, she had a severe attack of rheumatic fever, after which she suffered more or less from palpitation and dyspnœa; but with this exception and occasional "colds," her health was tolerably good up to about six months ago. Since that she has suffered more than before from palpitation and dyspnœa, being obliged at times to remain in bed for several days consecutively from apparently fresh attacks of rheumatism.

About a week before her admission she was suddenly seized with severe pain in the calf of the left leg and in the ankle and a sensation of numbness in the toes. There was some swelling around the ankle, but no redness; there was neither swelling nor redness in the calf of the leg. The lightest touch in the latter situation gave rise to intense pain.

On admission there was still intense pain in the left ankle and calf of the leg, but, as before admission, there was no redness, and the limb was of the normal temperature. The numbness of the toes was still present. The countenance was anxious, and expressive of great suffering. There was no pain in any other situation, not even along the course of the principal vessels of the limb under pressure. Pulsation could be felt in the femoral artery, and also in the course of the popliteal, but only indistinctly. There was a brownish discoloration of the skin of the lower and inner part of both thighs and inner side of the knees, and upon these discoloured parts there were minute cuticular scales. The eruption resembled that of pityriasis. There were no nodes discoverable. The pulse in the right wrist was moderately full, but soft, while that in the left was extremely small; number of pulsations, 90. The heart's impulse was unusually strong and heaving. Extent of cardiac dulness was considerably increased, both vertically and transversely. Systolic sound short, and accompanied by a harsh murmur, which was heard loudest near the apex, and upwards and outwards under the nipple; the second

sound was absent. The respiration was hurried; there was no cough; percussion-resonance dull over the base of the right lung, where the inspiratory murmur was harsh and blowing, and the respiration was accompanied by a medium sub-crepitant rhonchus. Some dry crumpling, as from emphysema, at anterior edge of upper lobe, and at apex. Resonance normal in other parts of this side; it was also normal over the whole of the left side, but the respiration at the base posteriorly of the left lung was accompanied also by a medium sub-crepitant rattle. The urine was in normal quantity, had a specific gravity of 1015, was acid, and gave no precipitate by heat and NO_5.

February 2nd.—Notwithstanding the administration of opiates in large doses internally, and their topical application, she has had scarcely any sleep, except for a few minutes at a time, since her admission, on account of the pain in the calf of her leg, which has sometimes been so agonising as to make her cry aloud. On the 31st of January (second day after admission) a purplish, irregular patch was noticed on the dorsum of the left foot; it occupied a space of about two inches in length by from an inch to an inch and a half in breadth; it did not disappear on pressure, and was not raised above the level of the surrounding skin. The temperature of the left foot was less than that of the right. This patch has been slowly and gradually extending in all directions. The left foot is now considerably colder than the opposite one. Pulse 120, extremely small, and weak.

6th.—Dry gangrene on the foot has considerably extended; it now occupies nearly the whole of the upper part of the foot. To-day a large bulla was observed on the inner side of the leg, a little above the ankle; it was filled with a dark-green fluid. This foot was several degrees colder than the right, and its sensibility almost lost.

7th.—The left foot is now œdematous. The bleb has burst, and the surrounding skin is of a greenish colour. The femoral artery can be felt pulsating feebly. Breathing is short and jerking; number of respirations, 41 in the minute; constant orthopnœa.

11th.—Between this and the last report the dry gangrene has been slowly extending, and involves now nearly the whole of the foot; there is as yet no evidence of any separation of the gangrenous part. The moist gangrene above has also extended, numerous blebs having formed at the periphery of the first patch, and a succession of them invading from day to day the neighbouring sound skin; the pain in the calf of the leg is much less, but there is now great tenderness to the touch or on motion, with preternatural heat in the popliteal space, and in the evening she complained of much pain and numbness in the right arm; there is no discoloration; the radial pulse at this side is scarcely perceptible.

13th.—The pain in the right arm was so great as completely to deprive her of sleep; prostration is now considerable; expression of countenance is extremely anxious and careworn; the temperature of this arm is somewhat lower than that of the left; no pulsation can now be felt at the wrist or in the course of the brachial artery; only a very slight pulsation can be felt over the axillary artery. From this time she began to sink rapidly, and died at 2·30 p.m. For nearly an hour previously to her death she was insensible, but there were no convulsions. Occasionally during her stay in the hospital she was delirious, but the delirium was never of a violent character.

Autopsy (thirty-five hours after death; weather cold).—Rigidity marked, but less so in the left lower extremity; body well nourished, upwards of an inch of sub-cutaneous fat over the abdomen; the left foot and four or five inches of the left leg were in a state of dry gangrene.

Head.—About an ounce and a half of clear fluid at the base of the brain. A superficial sub-arachnoid ecchymosis, of about the size of a sixpence, on the upper part of the right hemisphere. The brain and its membranes in other respects healthy.

Chest.—Both lungs were non-adherent. Weight of right, 20 oz.; that of left, $21\frac{3}{4}$ oz.; they were crepitant throughout, and very œdematous posteriorly, but there

was nowhere any consolidation; considerable emphysema along the anterior margins.

Heart much enlarged; the right cavities much enlarged, and both filled with dark coagula and grumous blood. The aortic valves were healthy; some atheroma around the orifices of the coronary arteries, but the aorta above was free from disease; left ventricle at the base measured $4\frac{3}{4}$ in., the thickness of its wall, 1 in. The curtains and edges of the mitral valve were covered with large vegetations (*a*), which projected more than an inch beyond the edges of the valve, and extended a considerable distance along the lining membrane of the auricle, and almost filled the appendix (*b*); the one by which this mass terminated was as large as a small hazel-nut; the superficial vegetations were so soft as scarcely to bear manipulation, while those at the base were made up of firmer material. The substance of the organ beneath and around the seat of the vegetations was infiltrated with a yellowish, puriform matter, which in some parts was exceedingly soft. In other parts (*c*) of the wall of the ventricle similar deposits were observed, and these also were friable. The carneæ columnæ were much enlarged, and the cordæ tendineæ thickened.

Arterial system.—In the right brachial artery (*d*) there was a firm coagulum, which extended from the point at which the anastomotica magna is given off to the bend of the arm, where the artery was separated. How far it extended beyond was not ascertained. The right and left carotids were free from coagula, as were also the arteries of the brain, so far as they were examined. Arch and thoracic portion of aorta free from disease. The abdominal aorta at the point of origin of the cœliac axis (*e*) was filled with a firm coagulum, as was also the cœliac axis itself, (*f*), but no vegetation could be discovered in these coagula. The coagulum in this portion of the aorta extended a little below the origin of the renal arteries. At the bifurcation of the aorta there were several yellowish-white masses, apparently of the same structure as the vegetations observed in the heart, which were partially surrounded by blood-

coagula, and this mixed mass extended for about half an inch into the common iliac on each side (*h, h*). Below this these vessels were filled by a blood-coagulum as far as their division, where there were other deposits of the same character as those seen in the mitral valve, surrounded by blood-coagulum, especially in the internal iliacs on both sides. At the points above mentioned (*f, g, h, i*) the adhesion between the vessels and the contained deposits and coagula was considerable, and the walls of the arteries were much thickened, and surrounded by and imbedded in dense fibrous tissue, so that the vessels could be removed from their situation only by careful dissection. Surrounding the deposits in the right internal iliac artery, the coats of the vessel were not only thickened, but were separated by a curdy, puriform matter (*j*), and in one part there was a cavity of the size of a horse-bean, filled with this matter; in fact, a small abscess. The same changes were observed in the left internal iliac, but the cavity was smaller. The external iliacs and femoral on both sides, as far as the origin of the profunda, were filled with coagula; at the origin of this latter vessel (*k*) the inner coat was separated from the outer coats by the same curdy, puriform matter as was observed between the coats of the internal iliacs; below this point, on the right side, the profunda was pervious. On the left side, both in the femoral and profunda, this separation of the coats, was extensive and penetrated for a considerable distance along the femoral; and about two inches below the origin of the profunda there was another fibrinous vegetation observed, and here likewise the inner layers were separated from the outer layers by a thick, puriform, curdy-looking matter; from this point the vessel was solid down to the division of the popliteal, where there was another vegetation observed, and where the walls were found in the same state. The large veins of the legs were filled with a firm coagulum, which adhered firmly to these vessels. (See Plate IX.)

Abdomen.—Liver, 70 oz. The left lobe adherent by recent lymph, and the capsule considerably thickened.

The inflammation was greatest where the left lobe came in contact with the diseased spleen. The rest of the organ appeared healthy, and the capsule of the right lobe was not thickened.

Spleen (*l*) measured seven inches long by three wide and two thick; its outer surface was connected to its surrounding parts by recent adhesions; the whole organ was much softened; at its lower extremity was a buff-coloured deposit; the structure of the organ in this situation was exceedingly friable, and seemed to be converted into a puriform mass. At the upper extremity there was another deposit, about half an inch thick and one inch in width; in the centre of the organ there were also numerous deposits of the same character.

Kidneys.—There were numerous cuneiform deposits in both these organs. Most of them were of a pale-yellow colour and of firm consistence, their bases, at the outer surface of the kidney were depressed, and the largest measured about half an inch in diameter; right kidney weighed $6\frac{1}{2}$ oz., and contained five or six deposits. The left kidney, being attached to the preparation, was not weighed, but seemed to be of the same size as the right.

Case 2.—Margaret Holloway, æt. 17, a servant of all work, admitted under the care of Dr. Stewart, March 5th, 1861.

This girl was of a spare habit of body, and her muscles were small and flabby. She was born, and had always resided, in London. She had smallpox when an infant, but no other disease, so far as she knows, until the age of fourteen (three years before her admission), when she had rheumatic fever. This attack is reported to have been complicated with pneumonia, but not with any cardiac affection. She had another attack of acute rheumatism a year and a half after the first. In this attack the heart was affected, and ever since she suffered more or less from dyspnœa on any unusual exertion, and severe pain in the chest. On the evening of the 1st of March (five days

before admission) she was seized somewhat suddenly with severe pain in the left side, which compelled her to leave her employment. On the following day, in addition to the severe pain in the side, she suffered from headache and a feeling of great depression. These symptoms continued up to the time of her admission into the hospital. She had always lived well, but had been much exposed to cold, and had frequently worked in damp clothes, to which she ascribed her rheumatic attacks. She never menstruated. There were no marks of scrofula.

On her admission the face was pale, features were pinched, and the expression anxious. The skin was not preternaturally warm; the pulse 96, slightly rebounding, and small; tongue somewhat pale, and slightly coated at the root; some appetite; bowels represented to be duly moved every day. Cardiac dulness from the body of the second rib to the upper border of the fifth rib; total of vertical dulness, four inches and three quarters; a rough murmur, seemingly diastolic, immediately following sharp second sound; it was heard from the second sterno-costal articulation downwards to the base of the fourth rib, and from the cartilage of this rib outwards to infra-axillary region; there was also a loud systolic murmur which entirely masked the first sound, and continued even during a portion of the second sound; slight fremitus between the third and fourth ribs. Percussion under the right clavicle slightly deficient in resonance, and the expiration was prolonged and blowing; increased vocal resonance as far as the fourth rib. On the left side the percussion-resonance, and the respiratory murmur, varied little from those of health. There was no morbid symptom referable to the abdomen or to the brain. She had no pain in any of the joints or in the limbs. The urine was somewhat scanty and high coloured. These symptoms progressively abated, and she appeared better in all respects until mid-day on the 8th, when she had a severe rigor of about an hour's duration, which was followed by a fainting fit, after that by free perspiration and also pain in the left knee-joint, and pain and swelling in the inner aspect of the right knee. Pulse 102,

moderately full, but jerking and easily compressed; respirations about 32, variable in frequency, deep, heaving, thoracic. The murmur at the base of the heart much less loud; that at the fourth rib was unchanged. Bowels open.

March 22nd.—From the 8th to the 20th the improvement was considerable, but on the morning of that day she awoke with a feeling of feverishness; the skin was dry and pungently hot; the tongue was dry and brown. On the previous evening she complained of pain in the right foot and toes, and on this morning (the 22nd) she had pain in the right hand, which was increased by pressure; pulse was variable, from the rate of 96 to that of 181, still moderately full, but jerking and very compressible. Respiration also very variable, from the rate of 14 to 28 in a minute, and entirely thoracic. The heart's sounds as before.

25th.—On the 23rd and yesterday she felt much better, but to-day complains much of pain in the knees, especially the left, which is puffy and tender, and its superficial vessels are enlarged; is perspiring freely; tongue clammy, and coated with a yellow fur at the root.

April 23rd (seven weeks since her admission).—Since last report she suffered from occasional pain in the knees and ankles, which never lasted long, and was seldom accompanied by swelling, and never by redness; but she was never entirely free from uneasiness in these joints, and without any manifest cause she had not progressed favorably, and continued to become weaker, more pallid, and more emaciated, in spite of tonics and a generous diet.

On the evening, however, of this day she was seized suddenly with pains of the most intense character in the lower extremities, occasionally lessening in severity, but recurring with former violence. The pain was principally below the knees. There was inability to flex the leg or move it in any direction; sensibility was gone below the knees and for about six inches above them, higher on the anterior than on the posterior aspect. No spasmodic muscular action could be seen or felt, nor were there any convulsive twitchings. The temperature was palpably much

below that of the surface of the body; quite cold at the feet, the warmth gradually increasing on approaching the trunk. The manner was excited, and she made frantic gestures and exclamations in her suffering. The skin was intensely hot, face flushed, breathing hurried, and heart's action regular, rapid, and vehement. The abnormal cardiac murmurs, before existing, were much intensified. There was no pain in the head, no perversion of the special senses, pupils were of normal size and readily influenced by changes of lights, and there was no tenderness along the spine.

25th.—She continued much in the state above described, with occasional remissions of the pain from the internal administration and local application of opiates. There is now complete loss of sensation from the middle of the left thigh downwards, and also from the corresponding part of the right thigh, except at the knee, which is painful under pressure. Temperature below the knee markedly deficient. No pulsation in the popliteal or femoral arteries; no œdema of the limbs, but the superficial veins on the dorsum of each foot are enlarged and prominent. On the plantar aspect, and at the extremity of the great and second toes, there are patches of blue discoloration. Feet are dry and harsh; pulse 108, full, and very firm; heart's action turbulent. The abnormal cardiac sounds very distinct; a mitral and aortic systolic, and a very loud, whirring aortic diastolic.

May 19th.—She continued in much the same state as last described, with intervals of ease, and with the gangrene slowly extending upwards, until to-day, when for the first time the pulse in the left upper extremity was found to be obliterated, and the limb was much colder than on the opposite side. At times there has been a good deal of delirium, but no other bad symptoms. She died quietly on the night of the 20th of May, ten weeks and six days after her admission, three weeks and six days from the symptoms of obstruction in the arteries of the lower limbs, and one day from those of obstruction of the artery of the left upper extremity.

Autopsy (May 21st, about 14 hours post-mortem).—Body much emaciated. Over the right knee a patch of livid discoloration, with some bulke. The right foot and leg were of a dull-red hue, apparently from gangrene. There was also a livid discoloration of the toes of the left foot and blackening of the left heel.

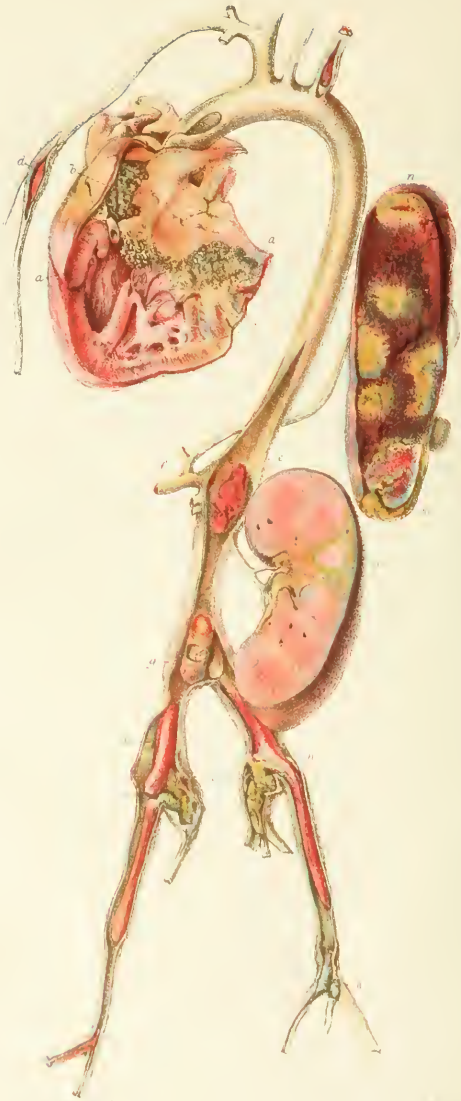
Lungs.—Over both lungs there were firm, old adhesions. The lungs throughout were unusually firm, but were everywhere crepitant. There were no indications of lobular pneumonia, and no plugging of the pulmonary vessels.

Heart.—Pericardium was universally adherent. The muscular tissue of the heart pale and flabby. Left side comparatively enlarged. On the auricular surface of the mitral valves, and on the lining membrane of the left auricle, were numerous soft vegetations. Some of them were loosely attached, and one, about two thirds of an inch long, was attached by a narrow pedicle, and could be flapped backwards and forwards with ease.

Arteries.—The right subclavian and commencement of the right axillary, the left carotid throughout its greatest length, the common, external and internal iliac arteries, on both sides, were obstructed by firm coagula, so as to resemble firm, rounded cords. Liver normal. Fibrinous deposits in the spleen and kidneys.

Head.—Over the right hemisphere of the brain, in the cavity of the arachnoid, was a thin layer of coagulated blood, measuring about three inches from before backwards, and extending from near the longitudinal fissure downwards into the right fissure of Sylvius, where there was a considerable coagulum, as large as a filbert, adherent to branches of the middle cerebral artery, so as not to be separated when water was allowed to flow over it. Several of the more minute branches of this vessel appeared plugged; that is, they appeared thickened, yellow, and opaque. These arteries were removed and put aside for careful examination, but were unfortunately lost. There was no softening of the cerebral substance.

The first case offers considerable difficulty with respect to the precise date at which the plugging of the larger vessels took place. The changes observed in and around the coats of the aorta, the iliacs, and the femoral, tend to show that considerable obstruction must have been present for some time before the complete occlusion of the right and left subclaviau and the posterior tibial arteries. The inflammatory process which led to the thickening of the coats at the seat of the plugging, and the formation of the large quantity of condensed fibrous tissue around, must have occupied a much longer period of time thau that which intervened between the date of the symptoms of complete obstruction of the left posterior tibial artery and the fatal issue. But be this as it may, this case is of great interest, as showing the changes which obstruction, more or less complete, of the arteries produces; first, with respect to the coats of the arteries themselves, and secondly, with respect to the neighbouring structures and the parts supplied with blood by the obstructed arteries. Where there was partial obstruction, as in that portion of the aorta at the commencement of the cœliac axis, as well as at its bifurcation, the inflammation was of that kind usually denominated adhesive, and the exuded matter was susceptible of some organization. Where the plugging was more complete the inflammation was of a more intense character, and was followed by the exudation of an albumino-fibrinous material, mixed with pus, or which soon degenerated into pus. (See Plate IX.) In the second case there is less difficulty in fixing the precise date of the obstruction. The period of time which elapsed from the first appearance of the symptoms to the fatal issue was comparatively short, and there was no very evident thickening of the walls of the obstructed arteries. In both of the cases the symptoms which indicate the sudden occlusion of the arteries were well-marked—intense pain at the seat of obstruction, and coldness and numbness, and absence of pulsation in the distal end of the affected limb.



Lith. imprimerie de F. Masterman, rue du Bac

DESCRIPTION OF PLATE IX.

a. Vegetations on mitral valve.

b. Appendix filled with vegetations.

c. Wall of the ventricle infiltrated with an exudation resembling the material of which the vegetations were composed.

d. The coagulum in brachial artery.

e. „ in aorta, opposite to the origin of the cœliac axis.

f. „ in the cœliac axis.

g. „ at the bifurcation of aorta.

h. „ in the common iliacs.

ii, *jj*. „ at the bifurcation of the iliacs, and the internal iliacs.

k. „ in the origin of the profunda and the femoral.

In the situations marked *e*, *f*, *g*, *h*, *i*, *j*, and *k*, the walls of the vessels were much thickened, and a thick layer of dense, cellular tissue had formed around them. In the situations *ii*, *jj*, and *k*, the coats were separated by a curdy-looking, puriform matter.

The spleen, showing several so-called fibrinous deposits.

n. Deposit, softened and converted into a puriform mass.

n. „ „ „

o. „ in the left kidney.

CASE

OF

ILIAC ANEURISM.

BY

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Received May 6th.—Read May 27th, 1862.

Two years ago I endeavoured to satisfy the members of this Society that the Hunterian operation had been too generally or rather exclusively adopted in the treatment of aneurism. In the case for which it was proposed, where the popliteal artery is no less inaccessible than the femoral is readily tied, the advantages of this method over that of opening the sac, and arresting the hæmorrhage by means applied directly to the bleeding orifice, were great and manifest, and naturally led to its immediate adoption for the particular purpose concerned. But there seems reason to think that this favorable impression had too much thrown into the shade what has been called the old operation, since the circumstances may be such as to reverse the reasons for preference, and render this procedure easier as well as safer than the other. For instance, in axillary aneurism the artery is readily within reach up to the clavicle, and may be exposed even higher than the part usually covered by this bone by elevating the shoulder, while ligature of the subclavian is generally a process of great difficulty, and also one of very considerable danger, since it has been ascertained

that at least 50 per cent. of fatal cases result from its performance. In reply to this argument, it is said that the vessel must be deemed unsound at the seat of its rupture, and more likely to bear a ligature with security where it is beyond the confines of the tumour; and it was to such an objection that in my former paper I particularly called attention, as, in regard to this part of the subject, the view which had previously been taken seemed to me erroneous and calculated to mislead.

The doctrine usually taught is that the whole extent of an artery included by the aneurismal sac should be deemed of suspicious soundness, if, indeed, not entirely absent, unless the case is traumatic or proceeding from a wound of the vessel, which, of course, does not imply any morbid condition of the coats; while the spontaneous form, occurring without any assignable cause, or resulting from such injuries as blows and sudden extension, has been held to do so. But even although it were granted that an origin of the latter kind affords ground for suspecting unsoundness at the ruptured part, it by no means implies a similar condition throughout the whole extent of the tumour. For the sac enlarges quite independently of any change in the vessel, and so far from weakening or destroying its coats, rather tends to consolidate and support them, by increasing the density of the surrounding parts. If, therefore, an artery is considered sound beyond the limits of an aneurism of the size of an egg, it should still be so regarded after the tumour enlarges to the bulk of an orange or any greater magnitude, the extent of arterial disease being in no wise proportioned to that of the aneurismal sac. Proceeding upon this principle, and trusting to find a sound portion of artery within the sac, I have repeatedly operated with success by laying open the cavity and securing the orifice by ligatures. Of the cases thus treated certainly the most remarkable is that which I am about to relate, and it so strongly supports the position in question that any further evidence in its favour would seem hardly to be required.

Robert Lattimer, a seaman, thirty-one years of age, about the end of November last, while working on shipboard, ran with great force upon the handle of a winch, which thus bruised his left groin. Considerable pain was felt at the time, and next day where the blow had been received he noticed a small tumour, which gradually enlarged and became so tender that he left the vessel and went to his home at the town of Annan, where poultices with fomentations were applied, under the impression that the swelling was of a glandular nature. In the course of a few days, the pain having subsided, although the tumour still remained, he again went to sea about the middle of December. Returning from a voyage to Ireland in the month of January, and while entering a harbour on the coast of Cumberland, he narrowly escaped drowning from the small vessel in which he sailed being run down by a steamboat, and to save himself leaped with all his force into another ship. Next day, about two inches higher up than the original one, he felt a new swelling, which became so painful that he applied for relief at the Carlisle Infirmary. There the tumour was recognised as an aneurism, and the patient, being led to regard the operation which had been proposed for its remedy as extremely dangerous, again went home. On the 20th of February, he repaired to the Infirmary of Dumfries, where interference was declined on the same ground. In this state, thus rendered hopeless, he once more returned home, and betook himself to drinking and smoking, with the effect of greatly deranging his health, while the tumour grew apace. He became much emaciated, with his pulse at 130, a troublesome cough, and other symptoms of alarming import.

At this period, Dr. Bogie, of Annan, kindly took an interest in the patient, and offered to send him to Edinburgh, to be under my care, if his health should improve sufficiently for the purpose. The hope of relief, thus held out, seemed to have a salutary effect, as such a change for the better took place that, on the 18th of April, he accomplished the journey of 120 miles by railway without any bad effect, and

was admitted into the Royal Infirmary. Upon examination, I found the tumour even larger than had been expected. It extended in length from below Poupart's ligament considerably above the umbilicus, and stretched from nearly two inches beyond the middle line of the abdomen, towards the right side, completely across the left iliac region, so as to overlap the crest of the ilium. Throughout the whole of this enormous swelling there was a strong pulsation and distinct aneurismal bruit; there was also great pain from pressure on the nerves, and considerable œdema of the thigh, from obstruction of the venous circulation.

From the history of this case it seemed probable that the artery had been ruptured in the groin, and that, if an opening were made into the sac, the pressure of the finger would prevent hæmorrhage, until the clots were turned out and ligatures applied. On the 20th of April, chloroform having been administered, I thrust a knife into the aneurism, about an inch above Poupart's ligament, and at the same distance from where the anterior spinous process of the ilium was supposed to be. Having inserted my forefinger, and found nothing but a confused mass of clots resting upon the bare bone, I made room for the middle finger also, and, still obtaining no satisfactory information, enlarged the wound sufficiently for thrusting in the whole hand, but with such force that the integuments embraced it tightly at the wrist, so as to prevent any escape of blood. I then ascertained that the artery was not in its proper place, and felt that it would be necessary to lay open the sac in order to discover the seat of rupture. But as this could not be done without causing a fatal hæmorrhage, so long as the circulation continued in the vessel concerned, I availed myself of a screw clamp which Professor Lister, of Glasgow, had had constructed for effecting compression of the aorta. This he applied so as to stop pulsation in the right groin, and I then, by means of a probe-pointed bistoury, at once dilated the wound to the extent of six inches, parallel with the crest of the ilium. By the united action of both hands all the blood and fibrinous clots, to the

amount of six pounds by measurement, having been scooped out, the surface of the sac was carefully examined, when a small oval aperture was detected in what might be called the roof of the cavity, towards its inner side, high up in the pelvis. Upon relaxation of the screw, a gush of blood left no room for doubt as to this being the arterial orifice, but, upon examination, it was found to be separated from the vessel by a very dense texture forming the sac. Having divided this, I dissected carefully, so as to bring the arterial coats distinctly into view, and passed a ligature on each side of the opening. When these were tied the blood still issued, though not with the same force as it had done previously, and we therefore inferred that the internal iliac originated from the portion of vessel which had been included. A ligature was applied, with the view of embracing it, and then the clamp was taken off, without any further bleeding. The edges of the wound were kept in contact by silver sutures, covered with dry lint, and gently supported by a bandage. The patient, who had slept quietly during the whole process, then awoke, quite unconscious of the arduous undertaking in which we had been engaged, and which could hardly have been accomplished without the assistance of Mr. Lister, and my colleague in the hospital, Dr. Watson, to both of whom my best thanks are due. Everything went on favorably afterwards: the patient was at once relieved from the pain, which he had been able to endure only through the use of large opiates, the œdema of his thigh quickly disappeared, and a slow but progressive improvement was observable in his general health. On the nineteenth day after the operation all the ligatures came away together, and then the wound gradually contracted.

Of the observations suggested by this case, one that seems very worthy of notice is the complete suppression of hæmorrhage which was effected by pressure on the aorta. The idea of doing this is not new, and upon various occasions it has been attempted with more or less success. But

I am not aware of its ever before having been tested by actual division of the primary arterial branches, and the evidence which has thus been afforded promises to be of much service, not only in operating upon iliac aneurisms, but also in amputating at the hip-joint,[1] or even, perhaps, in the treatment of uterine hæmorrhage.

When I began to advocate opening the sac, it was alleged by many, as a strong objection to this procedure, that the large cavity exposed would necessarily be productive of a profuse and long-continued discharge of matter, apt to exhaust the patient. But this apprehension proceeded from erroneously confounding the inner surface of an aneurism with the pus-forming investment of a chronic abscess, from which it is entirely different, being an organized texture that possesses no peculiar action, and is ready to undergo absorption so soon as the cause which produced it ceases to exist. Accordingly, the enormous cavity that was laid open in the case just related afforded little more discharge than might have been expected from an ordinary wound of the same extent.

From the common iliac being throughout its whole extent imbedded in the sac, it is evident that when the patient came under my care, and probably at a much earlier period, the artery could not have been tied without opening the cavity. This circumstance also affords a remarkable illustration of the safety with which ligatures may be applied to an artery within the confines of an aneurismal tumour.

In conclusion, I beg to express my hope that the cases of carotid, axillary, gluteal, and iliac aneurism, which have been treated by opening the sac and tying the artery at its place of rupture, may induce teachers of surgical principles to reconsider the propriety of representing the Hunterian operation as so exclusively the rule of practice as it has hitherto been regarded. For my own part, I feel persuaded that while aneurisms of the popliteal, femoral, and carotid

[1] My colleague in the Royal Infirmary, Mr. Spence, has lately availed himself of Mr. Lister's clamp in amputating at the hip-joint, with the effect of completely controlling the hæmorrhage.

arteries are proper subjects for ligature of the vessel without opening the sac, those of the axillary and iliac arteries should be treated by ligature at the seat of rupture, especially as I have shown that in both of these situations hæmorrhage may be effectually prevented during the operation by pressure applied nearer the heart.

Postscript.

September 6th, 1862.

This case was communicated to the Society only a month after the operation, in consequence of my having occasion to be in London at that time. The favourable anticipations of complete recovery then entertained were not realised, as the general health, from having been greatly impaired, did not improve in proportion to the local progress. The patient's state seemed very precarious until the end of nearly three months, when so decided a change for the better took place as to remove all anxiety. But soon after this, from unfortunately sleeping with an open window, inflammation of the pleura was excited, and it proved fatal on the 31st of July. On examination it was found that the external iliac had been torn completely across and drawn up into the pelvis, where its open mouth, being mistaken for a slit, had imposed upon the gentlemen who had assisted me, and myself, so as to make us suppose that the ligatures were applied immediately above instead of below the bifurcation of the common iliac, the whole extent of which was imbedded in the sac. The true state of matters, thus ascertained, tends to strengthen the principle of practice which it was the object of the paper to maintain.

CONTRIBUTION

TO THE

STATISTICS OF CANCER.

BY

W. M. BAKER, M.R.C.S.

COMMUNICATED BY

JAMES PAGET, V.P.R.S.

Received June 23rd.—Read June 24th, 1862.

The contribution to the statistics of cancer here presented to the Royal Medical and Chirurgical Society has been collected from notes of 500 of the cases taken by Mr. Paget between the years 1843 and 1861. The conclusions to be drawn from them may be added to, or incorporated with, those made by Mr. Sibley, and published in the 'Transactions,' vol. xlii. The number of cases is nearly the same as that from which his tables were constructed; and they are tabulated on the same general plan. Such additions as they may make to the facts which he has deduced, or such differences of conclusion as they may suggest, may be ascribed to their having been observed in an entirely different field, and, for the most part, in private practice.

The cases were recorded by Mr. Paget as they occurred, and without any reference to the particular kind of cancer, its seat, or its influence on the duration of life; none were either selected or omitted for any special reason. But in the 500 cases for which these tables are constructed only such cancers have been included as were external or might be called surgical, the so-called medical cases being omitted. Cases of cancer of the larynx, œsophagus, rectum, and bladder are included, but not those of the uterus, the cases

of which, in Mr. Paget's notes, were not sufficiently numerous to allow of any safe deductions worth adding to those arrived at from the very large number studied by Mr. Sibley.

The whole of the cases have come under Mr. Paget's own observation, and been diagnosed as cancer by him: in a large part of them the naked-eye appearances have been compared with the microscopical. They include hospital and private patients, in the proportion of about two fifths hospital to three fifths private.

Of the several kinds of cancer, five only, viz., scirrhous, medullary, melanotic, osteoid, and epithelial, have been taken. The villous and colloid varieties have been omitted, chiefly on account of their comparative rarity, and, consequently, the small number of cases noted by one observer.

Primary seat.

The various organs were affected primarily, in the following proportion:

	Males.	Females.	Total.
Intermuscular and other connective tissue	10	3	13
Bones	16	7	23
Lymphatic glands	10	6	16
Eye	2	2	4
Lips and cheeks	25	4	29
Gums and palate	6	3	9
Tonsil	1	1	2
Parotid	1	2	3
Tongue	19	11	30
Œsophagus	2	5	7
Larynx	2	1	3
Rectum	8	3	11
Urinary bladder	4	1	5
Integuments of limbs and trunk	13	5	18
,, scalp	1	1	2
,, nose and face	8	1	9
,, external ear	1	—	1
,, scrotum	7	—	7
Scars	3	1	4
Cutaneous moles and nævi	1	5	6
Testicle	14	—	14
Penis	6	—	6
Labia	—	2	2
Breast, right and left in equal proportion	7	269	276
	167	333	500

The far greater liability of females to be attacked by cancer is here well shown, the number of cases in them being almost double that in males; but it will be seen at once that this is due to the cases of cancer of the breast, for, on subtracting these from each table respectively, we have 160 cases of cancer in males, and 64 in females.

The results in Mr. Sibley's table accord mainly with the preceding, but, from his including cancer of the uterus, the proportion of females affected is much larger. On subtracting, however, the cases in the reproductive organs and breast in both sexes, as well as those in interual organs, which are added to his collection, the proportion remaining is considerably higher in males than females.

From the present cases being taken indifferently as they occurred in practice, and from their being, almost all of them, such as would apply for surgical help exclusively, the numbers may be taken to represent very fairly the comparative liability to cancer of each of the organs included in the table.

Variety of cancer, distribution, &c.

In the whole 500 cases the per-centage of each kind of cancer was as follows:

Scirrhous	55·6 per cent.
Medullary	17·6 „
Melanotic	3·2 „
Osteoid	0·6 „
Epithelial	21·4 „
Uncertain and intermediate	1·6 „

On further analysing the manner in which each variety of cancer is distributed, we find that, with rare exceptions, each organ is attacked by one form of the disease, almost exclusively.

This will be seen from the following table.

	Scirrhous.	Medullary.	Melanotic.	Osteoid.	Epithelial.	Total.
Intermuscular and other connective tissue	1	12	—	—	—	13
Bones	—	20	—	3	—	23
Lymphatic glands	3	12	—	—	1	16
Eyeball	—	1	1	—	—	2
Conjunctiva	—	—	—	—	1	1
Lips and cheeks	—	1	—	—	28	29
Gums and palate	1	2	—	—	6	9
Tonsil	1	1	—	—	—	2
Parotid	—	3	—	—	—	3
Tongue	—	—	—	—	30	30
Larynx	—	—	—	—	3	3
Rectum	1	10	—	—	—	11
Urinary bladder	—	5	—	—	—	5
Integuments of limbs and trunk	1	—	5	—	12	18
„ scalp	—	1	1	—	—	2
„ nose and face	—	—	2	—	7	9
„ external ear	—	—	—	—	1	1
„ scrotum	1	—	—	—	6	7
Scars	—	—	—	—	4	4
Cutaneous moles and nævi	—	—	6	—	—	6
Testicle	—	13	1	—	—	14
Penis	—	—	—	—	6	6
Labia	—	—	—	—	2	2
Breast	269	7	—	—	—	276
Œsophagus and (1) Conjunctiva	Uncertain variety			—	—	8
	278	88	16	3	107	500

Age.

No age is entirely free from a certain liability to cancer, but there are comparatively few cases among the very young. Amongst the present cases the earliest age at which the disease occurred was in a male infant, in whom medullary cancer of the ilium began when it was fifteen months old. A case of melanosis of the eyeball occurred in a male, aged two years; and two more of melanosis of the integuments in infants, three years old each, one male and the other female. The oldest patient was a woman, who began to suffer from epithelial cancer of the tongue when she was ninety years old.

It might be almost said to be a rule, for the external organs, that medullary and melanotic are the cancers of youth and early adult age, scirrhous, that of middle life, and epithelial, of middle and old age, so much do they affect these periods respectively; but a wide margin for exceptions must be allowed to each of them.

No case of cancer, other than medullary and melanotic, began before the age of twenty, with two exceptions, at the age of fifteen and seventeen, which were osteoid.

The majority of all the cases of medullary cancer in external organs, with one exception, began before the age of forty, and those in the bones and connective tissue before thirty. The exception was the breast, in which the seven cases of medullary cancer began between forty and seventy. This form of cancer, when attacking internal organs, begins, apparently, at a much later period of life. In the following table the rectum and bladder are examples of this fact, and, I believe, medullary disease of the pylorus is most frequent at about the same age.

Only five cases of scirrhous cancer of the breast began before thirty years of age, and the largest number, within ten years, occurred between forty and fifty. The cases of this form of cancer in other organs are not numerous enough for any conclusions to be drawn from them.

Only eight cases of epithelial cancer began before thirty, comparatively few before forty, and the largest number within ten years, between fifty and sixty years of age.

These particulars may be seen in detail by referring to the following table. By comparing it with that which precedes, the frequency of cancer of each kind, at each age, may be found without difficulty, as the several organs are so exclusively affected by their own particular form of the disease.

The numbers at the top represent the age, in periods of ten years, at which the disease began.

	0-10.	10-20.	20-30.	30-40.	40-50.	50-60.	60-70.	70-80.	80-90.
Intermuscular and other connective tissue	—	4	3	3	—	2	1	—	—
Bones	1	7	7	5	—	1	2	—	—
Lymphatic glands	—	—	1	4	4	5	—	2	—
Eyeball	1	—	—	—	1	—	—	—	—
Conjunctiva	—	—	—	—	1	—	1	—	—
Lips and cheeks	—	—	—	2	5	10	11	1	—
Gums and palate	—	—	2	1	3	3	—	—	—
Tonsil	—	—	1	—	1	—	—	—	—
Parotid	—	1	1	—	1	—	—	—	—
Tongue	—	—	3	5	8	8	3	2	1
Œsophagus	—	—	—	2	3	2	—	—	—
Larynx	—	—	—	1	—	2	—	—	—
Rectum	—	—	—	—	3	4	3	1	—
Urinary bladder	—	—	—	—	—	4	1	—	—
Integuments—									
Limbs and trunk	2	—	1	1	3	7	3	1	—
Scalp	—	—	1	—	—	—	—	1	—
Nose and face	—	—	—	—	2	4	3	—	—
External ear	—	—	—	—	—	—	—	1	—
Scrotum	—	—	1	3	1	2	—	—	—
Scars	—	—	—	1	3	—	—	—	—
Cutaneous moles and nævi	—	1	3	—	1	—	1	—	—
Testicle	—	—	4	7	3	—	—	—	—
Penis	—	—	—	2	2	2	—	—	—
Labia	—	—	1	1	—	—	—	—	—
Breast	—	—	5	41	122	65	35	8	—
	4	13	34	79	167	121	64	17	1

Sex.

The influence of sex upon the production of cancer at each age is shown in the following table.

Age.	Males.	Females.
0 to 30 there were	31	20
30 „ 70 „	129	302
70 „ 90 „	7	11
	167	333

The difference in the two sexes is, therefore, greatest during the period most prone to cancer of the breast. When the breast and organs of generation in both sexes are excluded, the proportion is as follows :

Age.		Males.	Females.
0 to 30	there were	26	14
30 „ 70	„	101	44
70 „ 90	„	6	4
		133	62

The following table has been made in order to show the relative frequency of cancer, at each age, in proportion to the whole population living at the same period. As it includes, like the others, only a few of the internal organs, which are affected most frequently in advanced age, it cannot be taken as a test of the frequency of cancer, except in external organs. For the same reason, and because a comparatively larger number of medullary cancers are thereby omitted, and of scirrhous included, the result does not clash with the statement in Mr. Paget's lectures,[1] that cancer increases in frequency from earliest to latest life.

The numbers represent the relative proportion, 1 being taken for convenience as the lowest.

Males.		Females.	
Age.		Age.	
0 to 10	1·0	0 to 10	1·0
10 „ 20	4·3	10 „ 20	3·8
20 „ 30	9·8	20 „ 30	26·2
30 „ 40	19·6	30 „ 40	108·7
40 „ 50	32·4	40 „ 50	371·0
50 „ 60	57·3	50 „ 60	288·0
60 „ 70	40·8	60 „ 70	240·5
70 „ 90	21·5	70 „ 80	89·3

The highest number among males, between fifty and sixty, and among females, between forty and fifty, might have been anticipated from the larger proportion, in the one, of epithelial cancer, and in the other, of scirrhous.

[1] 'Lectures on Surgical Pathology,' vol. ii, p. 546.

Social condition, &c.

Influence of marriage, &c.—The condition of the female patients, whether single, married, or widow, was noted in 260 cases of cancer of the breast, the proportion being—

Single	23·0 per cent.
Married	72·4 „
Widow	4·6 „

The per-centage of each in fifty-four cases of cancer in other organs was—

Single	20·4 per cent.
Married	68·5 „
Widow	11·1 „

The per-centage of single women in cases of cancer of the breast is smaller than that in the female population generally,[1] and the table would therefore indicate a greater liability in the married than the single to be attacked by cancer in this organ.

The proportion agrees very closely with that given by Mr. Sibley, if the married and widows be taken together; the latter forming, in his table, a larger number than the single.

Pregnancy.

Of 163 married women suffering from cancer of the breast, 126 were fruitful, 37 barren. Of 25 cases of cancer in other organs, 22 were fruitful, 3 barren. But the number is too small to allow of a very fair comparison being made between them and the cancers of the breast in this respect.

Catamenia, &c.

In 75 cases of cancer of the breast, between the ages of forty and fifty-five years, the state of the catamenia at the time of beginning of the cancer was ascertained.

[1] See 'Insurance Guide and Handbook,' London, 1857.

The disease began in—

48 before their cessation.
12 about the time of „
15 after „ „
—
75

State of health, &c.

The state of the patient's health at the beginning of the disease was recorded in 437 cases of cancer of all kinds, and of these—

72·5 per cent. were in good health.
19·7 „ „ in indifferent health.
7·8 „ „ in bad health.

It would seem, therefore, as if no conclusion, with respect to the constitutional origin of cancer, can be drawn from the good or bad condition of the patient's general health at the time of its first appearance.

Some difference, but not very much, existed between the varieties of cancer in this particular.

In scirrhous cancer 5·2 per cent. were in bad health,
In medullary „ 10·9 „ „
In epithelial „ 9·7 „ „

when the cancer was first noticed.

Inheritance.

The presence or absence of cancer in other members of the patient's family was recorded in 322 instances, cancer of all kinds being included in this number. 78 of these, or 24·2 per cent., had had one or more cancerous relatives: again, 13 of the latter had had two, and 5 had had three, relatives affected with the disease.

The difficulties in obtaining a correct family history from hospital patients are, as Mr. Sibley remarks, considerable, and it is, probably, from the present table including a large number of private cases, in whom the family history would be better known, that the per-centage (24·2) is so much greater than that given by him in his paper ($8\frac{3}{4}$).

This is made more likely still from the per-centage of cancerous inheritance being, among the private cases, 27·4, against 17·9 among hospital patients. The kind of cancer was not always the same in all the members of the family who were attacked.[1]

Recurrence after operation, &c.

The following tables have been made in order to show the times of recurrence of the disease after operation. No case has been included unless the operation was a complete one, the whole of the apparent disease being removed; and cases in which lymphatic glands that were sensibly enlarged at the time of operation afterwards increased, with signs of cancer in them, have been also omitted.

The first table shows the date of recurrence in the several varieties of cancer, the figures at the top representing the number of months after the operation at which the disease recurred, and those opposite the name of the cancer, the number of cases.

	1-3.	3-6.	6-12.	12-18.	18-24.	24-30.	30-36.	36-42.	42-48.	48-54.	78-84.	Total.
Scirrhous .	9	17	15	9	4	—	2	1	1	2	2	62
Medullary .	4	6	3	1	2	—	—	—	—	—	—	16
Melanotic .	6	1	1	—	—	—	—	—	—	1	—	9
Osteoid . .	1	—	—	—	—	—	—	—	—	—	—	1
Epithelial .	11	4	7	1	—	—	—	—	—	—	—	23
	31	28	26	11	6	—	2	1	1	3	2	111

The average date of recurrence in each kind of cancer, as deduced from this table, is—

Scirrhous cancer	. . .	13·9 months.
Medullary ,,	. . .	7·4 ,,
Melanotic ,,	. . .	8·6 ,,
Epithelial ,,	. . .	5·1 ,,

The average here given for scirrhous cancer agrees very nearly with that stated by Mr. Sibley. The date of recurrence for the other kinds is not given by him.

[1] For more details concerning the transmission of cancerous and other tumours, see 'Med. Times and Gazette,' Aug. 22nd, 1857.

Excepting the breast, the number of cases, when divided, was hardly enough to justify the making a comparison between the dates of recurrence in the several organs.

Some cases, more favorable in their late recurrence, must be added as an appendix to these.

Thus, 6 cases of scirrhous cancer of the female breast are living from thirty-four to ninety-four months after the operation; one case of medullary disease in the forearm forty-two months, and 8 of epithelial from forty-one to a hundred and ten months after it; all of them without any local recurrence.

The most remarkable case is that of a sweep, who began, thirty-five years after the removal of soot-cancer from the scrotum, to suffer from epithelial cancer in the finger and hand. It is probable that this was a case rather of fresh disease, from the same exciting cause, than of recurrence.

There is one source of error in this table, due to the fact that the poorer patients, after leaving the hospital for their own homes, are often lost sight of altogether, unless the rapid return of their complaint obliges them to come again, and seek relief at the same institution. In this way the cases of quick return of the disease would be probably seen again by the operator, while those which were delayed for many months or years would often never be heard of again by him, for many reasons well known to all who have to do with hospital patients.

Perhaps the most striking result from the foregoing table is the great similarity that exists between the several kinds of cancer in their rate of return after removal by operation. The difference so commonly supposed to exist between epithelial cancer and the others, in this respect, disappears altogether, the only point in which the former seems to have an advantage being that more of the cases live without recurrence for a period far beyond the general average.

Influence of age on the recurrence of cancer.

The influence of age on the recurrence of cancer after removal is, apparently, but slight, or rather its expression is

but a repetition of the statement as to the influence of the kind of cancer most frequent at each age.

In only one case before the age of thirty did recurrence succeed the operation at a greater distance of time than two years. It was a case of melanosis, returning four and a half years after removal. The cases of scirrhous cancer returning at about the same period were aged forty and fifty years, and the two returning at between six and seven years happened in persons, aged fifty-six and seventy-two years respectively.

Influence of early and late operation.

So that the disease is completely removed by the operation, the early or late performance of the latter appears to exercise about the same influence on its progress. This is, most probably, from the early operations being undertaken for the acute and rapidly growing cancers, such as most alarm the patient and make him seek for advice without delay; and these are also such as may be expected to return quickly after removal.

In the following table the date of the operation is expressed by the number of months or years which intervened between the patient's first observation of the cancer and its performance; and the date of recurrence is given also in months which elapsed after the operation, and during which the patient was free from apparent signs of the disease.

The figures, added together, represent, as before, the number of cases.

Date of operation.	Date of recurrence.										
	1-3.	3-6	6-12.	12-18.	18-24	24-30.	30-36.	36-42.	42-48	48-54	78-84.
1—3 months .	4	8	2	—	—	—	—	1	—	—	1
3—6 ,, .	10	2	5	3	2	—	2	—	—	—	—
6—12 ,, .	8	7	7	5	—	—	—	—	—	2	1
1—3 years .	6	6	4	2	2	—	—	—	—	1	—
3—5 ,, . .	3	5	8	1	1	—	—	—	—	—	—
5—7 ,, . .	—	—	—	—	1	—	—	—	1	—	—
	31	28	26	11	6	—	2	1	1	3	2

The average date of recurrence taken from this table was—

Date of operation.		Date of recurrence.
1 to 3 months	. . .	11·4 months.
3 „ 6 „	. . .	9·4 „
6 „ 12 „	. . .	12·2 „
1 „ 3 years	. . .	9·4 „
3 „ 7 „	. . .	10·1 „

The reason that the recurrences are not more distant from the late operations performed for the chronic cancers is, very possibly, to be found in the fact that so large a proportion of patients apply for relief when such cancers are beginning to increase rapidly, and, therefore, when they are more analogous with those which are acute from the commencement.

In the instances just mentioned of recurrences delayed for a very long time, or of none taking place at all, no relation between either event and an early or late operation was observed. The times of operation varied from one month to three years after the patient's first noticing the cancer; one was operated on seven years, and another nine years, after its first appearance.

The last is a remarkable case, and the more recent history of it has been obtained since the tables of the duration of life were drawn up. The tumour was a medullary cancer, circumscribed, and situated between the muscles of the forearm. It was removed nine years after its first appearance, and the patient is now alive, three and a half years after the operation, without any local return of the disease.

Influence of operation upon the duration of life.

In the tables which follow, and in which the duration of life in those not operated on has been compared with that of cases in which the primary disease was removed, some allowance must be made for the patients included who are still living. As many of these are in good health, and may

yet live for a considerable time, the average length of life may be taken to be rather longer than these tables, by themselves, would show.

Thus, among those not operated on, 8 cases of scirrhous cancer of the breast are still living, at periods varying from 54 to 126 months after the first notice of the disease.

Among the cases of operation have been reckoned 8 patients with scirrhous cancer, who are living from 61 to 141 months, and one case 200 months, after its first appearance; 4 of medullary, at 12, 73, 76, and 150 months respectively, and 12 of epithelial, from 53 to 162 months, after the same date.

In the tables, the figures, added together, as before, represent the number of cases. None of those in which death took place as the immediate consequence of the operation have been included.

The cancers of the larynx, œsophagus, rectum, and bladder have been excluded, as they would appear on one side only of the table, viz., among those not operated on.

Duration of life after first observance of cancer.

	Months.				Years.									
	1-6.	6-12.	12-18.	18-24.	2-3.	3-4.	4-5.	5-6.	6-7.	7-8.	8-9.	9-10.	10-11.	11-12.	12-14.	16-17.
Scirrhous—																
Primary disease not removed	3	10	8	12	15	7	10	7	2	3	4	1	1	—	1	—
,, removed .	—	3	5	5	11	6	4	10	4	4	4	1	1	1	2	1
Medullary—																
Primary disease not removed	5	10	5	4	5	—	1	—	1	1	—	—	—	—	—	—
,, removed .	—	4	4	2	—	—	2	2	2	—	—	—	—	—	—	—
Melanotic—																
Primary disease not removed	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
,, removed .	—	1	2	1	2	—	—	1	—	1	—	—	—	—	—	—
Epithelial—																
Primary disease not removed	1	6	6	1	4	3	—	—	—	—	1	1	—	—	—	—
,, removed .	—	1	5	4	3	4	5	3	—	1	—	4	1	2	2	—
Total .	9	35	35	29	40	21	22	23	9	10	9	7	3	3	5	1

The average length of life taken from this table is—

	Primary disease not removed.	Primary disease removed.
Scirrhous cancer	43·0 months	55·6 months.
Medullary ,,	20·0 ,,	33·4 ,,
Melanotic ,,	—	44·6 ,,
Epithelial ,,	27·4 ,,	57·6 ,,

In cancer of all kinds the average length of life is—

Primary disease not removed	30·0 months.
,, removed	47·8 ,,

It is hardly necessary to observe that the striking difference in the length of life, in all the varieties of cancer, according as the primary tumour is or is not removed, is due, in a great measure, to the more favorable cases being those for which an operation would be most often undertaken. But though it would be impossible to tell exactly how far this may account for the contrast, it seems almost certain that the operation in itself has a tendency to prolong life. This, however, is not a question which statistics alone would answer.

The greatest contrast is shown between the epithelial cancers operated on and those not interfered with; and this corresponds also with the great contrast between the chronic, superficial, and easily removed form on the one side, and the acute, rapidly infiltrating form on the other.

The rate of mortality here given for the two classes (including all kinds of cancer) differs from that stated in Mr. Paget's lectures, the difference being probably due to the greater care exercised in the selection of cases for operation during the last ten years.

Influence of age on the duration of life.

The age of patients seems to have but little influence in determining the length of life, except by its connexion with the kind of cancer.

Amongst those not operated on (including the cases in

all the organs), the duration of life at each age was as follows:

Age.	Average length of life.
0 to 30 years . . .	19·0 months.
30 „ 50 „ . . .	34·7 „
50 „ 90 „ . . .	32·1 „

Amongst those operated on:

Age.	Average length of life.
0 to 30 years . . .	35·4 months.
30 „ 50 „ . . .	52·3 „
50 „ 90 „ . . .	56·0 „

Influence of the seat of cancer on life.

In only a few of the several organs in which the whole duration of the disease was known, were the cases sufficiently numerous to allow of an average being taken for them separately; and in three only, the breast, the tongue, and the bones, were the numbers enough to compare those operated on with the rest. The average duration of life in each was as follows:

	Primary disease not removed.	Primary disease removed.
Breast	43·0 months	57·6 months
Bones	23·6 „	23·6 „
Tongue	22·7 „	35·0 „
Intermuscular and other connective tissue .	14·6 „	—
Lymphatic glands . . .	13·6 „	—
Lips and cheeks . . .	—	79·3 „
Gums, palate, and tonsil . .	12·1 „	—
Rectum	29·2 „	—
Integuments of limbs and trunk . .	—	58·0 „

The difference in the fatality of epithelial cancer according to its seat in the tongue or integuments is well marked.

It would seem also from this table that the operation made no difference in the length of life in cases of medullary cancer affecting the bones.

The average duration of life given in Mr. Sibley's paper for cancer of all kinds not operated on is 23·6 months, a number smaller than that given here. Part of this difference may be accounted for by his not including the patients still living, and by cancers of the uterus forming a considerable proportion of the whole number of his cases, the average for the latter being only 14·1 months.

The average in the same paper for cancer of the breast not removed is 32·25 months, and when removed (not including the deaths from operation) 56·6, the latter number very nearly corresponding with that given here.

The average duration of life of epithelial cancer not removed is, in Mr. Sibley's paper, fifty-three months, but it is deduced from cancer of the lips only.

Influence of early and late operation.

Concerning the influence which early or late operation may have in prolonging life, almost the same remarks are applicable with those which were made about the recurrences.

The following table has been constructed from 124 cases.

Date of operation.	Average length of life after operation.
1 to 6 months	32·9 months.
6 „ 12 „	31·8 „
1 „ 2 years	33·6 „
2 „ 5 „	46·7 „

Four cases, in which the operation was performed six to ten years from the beginning of the disease, lived from three to seven years.

As in the cases of recurrence, many of which are included in the present table, so here the inferences which might otherwise be drawn from the date of the operation and its influence on the length of life are rendered void by the acute cancers being those which are the earliest to be removed and to return, and the chronic the latest. All the varieties of cancer come under this rule.

The whole number of operations recorded in the cases was 239, and the deaths twenty-four: the mortality was almost exactly, therefore, 10 per cent.

The deaths included five amputations of the thigh, two of the leg, twelve removals of the breast, two of the testicle, and one of each of the following:—cervical gland, medullary tumour in the neck, and an epithelial tumour from the cheek. Altogether, there were 109 cases of removal of the breast, and twelve of these died, the mortality being again about 10 per cent.

Duration of life in hospital and private cases compared.

It would be probably necessary to obtain a very much larger number of cases than are taken in the present paper, to settle certainly whether any difference exists, as regards length of life, between hospital and private patients. It seemed, however, worth while to compare these two classes so far as was possible here, and the result was as follows. Of cancer of all kinds, in which the duration of life was known and the condition of the patient recorded, there were 87 hospital and 193 private, and the average duration of life was about forty-two months for hospital, and thirty-seven months for private cases.

Excluding cancer of the breast, the average was 36·1 months for the hospital patients and 30·3 for private; and for cancer of the breast alone, about fifty-seven months for hospital, and forty-three for private patients.

The difference between the two classes may, however, be ascribed, at least in part, to a larger proportion of the hospital cases being submitted to operation.

REPORT

UPON

SYPHILIS,

WITH REFERENCE TO THE MORE MIXED AND UNUSUAL FORMS OF THE PRIMARY SYMPTOMS.

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In the following paper the writer desires to speak of syphilis, as it is presented to the army medical officer, with especial reference to its more unusual, mixed, and anomalous forms. For the sake of brevity, he wishes it to be understood that he has not here recorded all the observed facts, but such only as may directly point and illustrate his observations.

Recognising, as every one must, the general truth of Ricord's teaching, it was not long, however, before the author discovered that the etiology and pathology of this disease were by no means so settled as the positive assertions of the French school would lead us to believe. When model cases presented themselves, the diagnosis

and prognosis were easy. That a case of indurated, indolent, non-suppurating, single sore, preceded by a relatively long period of incubation, with symmetrical affection of multiple inguinal glands, and without any tendency upon their part to suppurate, was surely followed by constitutional symptoms, was true enough. Likewise was it true that multiple, soft, suppurating sores, following a relatively far shorter period of incubation, with open bubo, and both chancres and bubo giving a highly contagious auto-inoculable virus, were the products of a local process only. But it was the frequent occurrence of mixed cases, of sores of various kinds and forms, that offered such great difficulty.

Putting aside all question as to the objective signs by which an infecting can be differentiated from a non-infecting sore, there can be no doubt whatever that these two varieties or species exist. Not only is this proved by the result of daily observation and experience, but it has been more positively established by the experimental proofs obtained by confrontation and syphilization. Danielssen, as the result of his inoculations of patients suffering Norwegian leprosy with chancrous virus, never found constitutional symptoms to follow, with one exception; and herein the virus was obtained from an indurated sore.[1]

In typical examples, what peculiarly marks the soft chancre is a solution of continuity of the soft parts by an ulceration and suppuration, having in its origin and progress an intimate connexion with an active inflammatory process. In the infecting form we observe a slower process of abnormal nutrition in the part affected, by which is induced a localized product partaking of the nature of a morbid growth, without any necessary relation to inflammatory phenomena: for these reasons it is

[1] In this instance the inoculation was at first followed by the usual reaction. At the end of one month, however, the ulcer became specifically indurated, and secondary infection of the system subsequently followed. The interest and bearing of this fact will be perceived by the reader hereafter.

relatively chronic in its course, and capable of removal by a gradual process of absorption, without the production of pus, or any loss of substance. In the first, the virus (as holds in the case of a mechanical substance) may pass by the lymphatics, be arrested at the nearest gland, and there induce a repetition of that same inflammatory process it originally caused; while in the second, the sphere of influence exerted by the virus is much wider, affecting the vascular as well as the lymphatic absorbents, by which it happens that the blood-elements, passing through both the chancre and gland-structure, become affected.

That the primary, and a few of the forms of secondary syphilis are contagious, has been settled by experiment and observation.

There would seem to be good grounds for believing that syphilis, as a disease, has a wider sphere of contagion than is generally attributed to it. Positive facts there are in abundance to make one hesitate before giving a decided opinion as to the absolutely non-contagious properties of any of the fluids obtained from the body of a syphilitic patient.

Without going so far as Langlebert, in believing that by far the larger proportion of syphilitic sores are the products of a virus from secondary lesions, we are met by great difficulties in explaining the earlier history of syphilis and the continuance of the disease to the present date, unless we believe in the contagiousness of other than the primary symptoms.

It would be a libel upon humanity to suppose that men suffering from primaries willingly spread the disease; and it is impossible to explain how a woman can infect many persons over a long period, if the uterine discharges, so commonly present in women constitutionally syphilised, are not also the vehicles of contagion.

What requires to be determined is—those conditions of system of a person suffering from syphilis which render the secretions so active at one period, as compared with another; and likewise the state of the system of the recipient of the virus, rendering him liable to take the disease.

The majority of cases of infecting sore are not pustular at their commencement, this form belonging almost exclusively to the soft, non-infecting sores, as Mr. Henry Lee has pointed out. Suppuration is not the ordinary pathological product of true syphilis.

The ulceration or erosion in an infecting sore is ordinarily very limited, not commonly penetrating the whole thickness of the skin or mucous membrane, although the induration may have a much deeper seat.

From an infecting sore so characterised some epidermic or epithelial scales will necessarily be mixed with the scanty excretion obtained from its surface, in addition to lymph-cells, which will approach the characters of pus, as the infecting possesses the characters of the non-infecting sore, viz., depth of erosion, activity of progress, and vascularity. The line of demarcation between the two sores, however, is not easily drawn from the character of the discharge alone.

Ricord himself taught the *unicity* of the virus, and referred the varied products to modifications induced by the constitution, &c., of the individual. He also long believed that auto-inoculability afforded a positive test of syphilis.

Asserting that an indurated chancre was the only portal through which the virus gains admission to the system, Ricord was compelled by his observations to perceive that such induration varied much in degree.

Mr. Henry Lee had the merit, in 1856, of pointing out the difficulty of auto-inoculation from an indurated sore. There seems now to be good ground for supposing that the two varieties of sore, infecting and non-infecting, ought to be regarded rather as separate species, depending upon a duality of virus.

Besides the proofs offered by Mr. De Meric, Diday, De Clerc, and Rollet, we have the exhaustive series of observations by Bassereau to prove that neither in age, sex, constitution, nor tissue really lies the cause of the differences between the infecting and non-infecting sores, irrespectively of a specific cause or virus; to differences in which we must look for this duality in the diseases.

A battery of artillery was stationed at Christchurch during eight months. Among all the cases of venereal (of which there were many) in one only was an infecting sore present; and in this instance I learnt that the virus was a London one, although contracted at Christchurch.

It would be right here to notice the opinion held by many as to the accumulative action of several venereal sores, contracted at different times. Recognising that an individual may have repeated attacks of primary sores, and that secondary disease often follows the last standing in the series, they have come to regard the constitutional symptoms as due to the accumulation; in short, that it was "the last straw that broke the camel's back," and not that the last of the series differed from the others in nature, and was itself the cause of the secondary infection.

Now, if we have regard to syphilitic disease as a whole, we find the morbid chain of phenomena too definite in type, and regular in order, to support such a view; not to mention the positive facts in abundance of secondary infection following the first contracted primary sore, if of infecting type.

That the appearance of secondary symptoms may be irregular and protracted in some cases is doubtless true. Constitutional symptoms, the product of a prior infection, may thus appear after the healing of a soft sore, and may be erroneously referred to it as the cause.

It is now many years since Lawrence pointed out that the physiological properties of tissue effect modifications in the character of venereal sores. Ricord, in twenty-five years' experience, never saw a well-marked soft chancre upon the face. This negative observation is now opposed by the experience of Continental inquirers,[1] and the chief ground for supporting the doctrine of a specific unicity of the virus has been cut from under the feet of those who hold that view.

When an ulcer is wide, though superficial, and the tissue

[1] Puche, Rollet, and Bassereau have succeeded in producing the "soft sore" upon the cephalic region by inoculation.

upon which it is seated areolated, any variety of sore, boil, or pimple tends to induce surrounding hardness, particularly if such sore be chronic or subjected to irritant applications.

If ulceration involves the integument or the superficial and closer layers of areolated tissue, and the amount of new matter thrown out is great, this granulation-material, which at first is large, succulent, and composed of spheroidal cells, eventually, as the absorption of fluids and advancing organization cause contraction and condensation in the new products, leads to a certain degree of hardness at the periphery of the sore.

Indolent sores also show a tendency to hardness; *e. g.* cracks about the tongue, sores upon the buccal membrane, ulcers over the tibia, fistulæ leading to sequestra, &c.

Irritation, implying an increased and morbid nutrition, proverbially induces hardness, as any one may prove by the application of caustic to any venereal sore.

As Mr. Henry Lee has well remarked upon the sore which involves the areolar tissue (phlegmonoid suppurating sore)—"From the amount of effusion, in order to limit an inflammatory action, the sore is here surrounded by much induration, which, however, does not terminate abruptly, unless upon the confines of a neighbouring tissue structurally different."

There is also a greater tendency to suppuration in sores affecting loose glandular, than dense parenchymatous tissues. How frequently an ulcer upon the glans penis discharges pus, and copiously, compared with one upon the prepuce!

Case 1.—Gr. C—, seven days after connexion, got a sore. He went to hospital upon the following morning, and the ulcer was cauterized with nitrate of silver. For the last fifteen days he has only applied water-dressing and black wash. Upon the upper surface of the prepuce there is an oval, superficial, indolent-looking ulcer, which extends upon the glans. This ulcer may be divided into two parts by the different tissues involved; two thirds of

it being upon the prepuce, indurated, and discharging sparingly; one third upon the glans, soft, and suppurating freely. The line of demarcation between the two is accurately defined by the cessation of the hardness at the corona. After washing this sore carefully, a piece of lint was applied, and retained *in situ* by the prepuce being drawn over the glans. The following morning the lint was removed. Viewed by transmitted light, two parts were tolerably accurately defined. The larger portion was moist; the smaller, corresponding to the soft part of the chancre, was yellowish and creamy. By needles the lint was torn, and the fluids from the different parts transferred to slides. Examined with the quarter-inch glass, with and without acetic acid, the yellow part gave a field of numerous pus-globules. The transparent, moist part gave globules (with epithelium), far fewer in number, and having all the appearance of pus-globules; although, to be guilty of a great refinement, the nuclear particles were less marked after acetic acid, and the cell-wall less distinct, than in the former.

Having premised thus much, as essential to the right appreciation of what follows, I propose to treat of—

I. The varieties of infecting sore.

II. The results of auto-inoculation.

III. The occurrence of syphilitic infection after suppurating bubo.

IV. The occurrence of constitutional symptoms following an urethral discharge clinically identical with gonorrhœa.

V. The bubon d'emblée.

VI. The periods of incubation preceding the appearance of the two kinds of venereal sores, and the absence of any proof that we can guarantee against constitutional infection by any abortive treatment applied to the primary syphilitic lesion.

I. Excluding the typical Hunterian chancre, and ulcer possessing the specific induration, we find that superficial

erosions, involving but a part of the integument or mucous membrane, and leaving scarcely any induration about the cicatrix, are the frequent precursors of general syphilitic infection.

The observations of Bassereau, Sigmund, and Vidal show this.

Bassereau's table of 170 *cases of syphilitic erythema.*

After superficial erosions . . .	146	times.
Circumscribed ulcers, with abrupt edges, involving the whole thickness of skin or mucous membrane . . .	14	„
Phagedænic sores	10	„
	170	„

Such superficial erosions are chronic in their nature, indolent in their action, and so trifling in extent as often to escape the detection of the individual. Upon the glans penis an infecting sore may appear as a localized "rawness," or as a mere dull discoloration, with shedding of the epithelium, and without the slightest trace of induration.

Seated upon the prepuce, these erosions will frequently induce an indurated state of the preputial tissue and phimosis. That the date at which such induration appears varies very much I am pretty positive, although the limits within which it may do so are difficult to determine. Ricord states that induration appears most frequently during the first or second week *after contagion;* never before the third day, or after the third week. From this it would follow that, if a chancre is to be indurated, it will be so by the twenty-first day after the date of contagion. I have lately, in two cases, seen induration appear at the base of a sore upwards of one month after the commencement of such sore. This late appearance of induration is not uncommon, judging from my own observation. Upon the other hand, no chancre has shown the characteristic induration earlier than three days from the appearance of the sore.

Ulceration, as generally understood, may scarcely affect such sores at all.

When the induration proper to the specific morbid process is situated in the hardness belonging to the seat of the sore, whether arising from the physiological properties of the affected tissues or induced by irritation, we may have an infecting sore most difficult of diagnosis: when, moreover, the subject of this disease has a hybrid affection, *e. g.* sores of different characters upon the same spot, we may have a pus-producing and infecting sore, capable of auto-inoculation, and attended with suppurating bubo.

Case 2.—In 1854, a respectable-looking man presented himself at the Newcastle Dispensary, with an indurated sore upon the fossa glandis and symmetrical enlargement of the inguinal glands. He was indignant at the diagnosis formed, stating that he was married, and was positive that he had had no intercourse with any one but his wife. He directed me to visit his wife, which I did; and I found upon the inner aspect of the left labium a slight excoriation, without the least trace of hardness, and without appreciable discharge. The woman was ignorant of the presence of any disease, and I hesitated as to its nature.

She subsequently had secondary syphilis, and about six weeks afterwards her husband became similarly affected.

Case 3.—Lieut. —, sixteen days after connexion, noticed a very trifling circumscribed redness upon the prepuce. He was not aware how long it might have existed. It looked slightly more vascular than natural, and the epithelium had an appearance of dulness, compared with that of the neighbourhood. Four days afterwards it became raised into a small prominence, not unlike that produced by the sting of an insect, or a miniature spot of erythema nodosum, without, however, any discharge or apparent loss of substance. One day, after having dusted the part with some powder and taken hard exercise, he noticed that there was a trifling discharge, and some exudation of epithelium took place, rendering the diseased spot moister than usual. At a later date, numerous very

minute depressions appeared upon the surface, evidently from molecular disintegration, and this was the only symptom of ulceration at all. A prominence remained at the seat of the disease. He had enlarged inguinal glands, and subsequently suffered from psoriasis palmaris.

Case 4.—Gr. McK—, æt. 24, four days after connexion, had three superficial sores (soft) upon the surface of the glans, with balanitis. These all healed by local treatment.

Eighteen days after connexion, and as he was about to be discharged from hospital, a sore appeared upon the prepuce, which became a regular Hunterian chancre, and from which inoculation proved unsuccessful.

Case 5.—Gr. S—, æt. 22 (a recruit). First attack. Date of contagion uncertain. Sores appeared upon the 12th of December. Admitted on the 15th, with two soft sores on the fossa glandis, discharging pus, from which he was inoculated successfully on the 17th, and reinoculated successfully on the 19th with virus obtained from the artificial sore; both of which were then destroyed by caustic. Local astringent applications to the sores on the penis. There was no bubo.

Upon January 1st, the chancres on the penis had become indurated, and healed with an indurated cicatrix. The results of the artificial inoculations healed quickly, without induration. Constitutional syphilis subsequently appeared, as a roscolo-squamous exanthem.

Case 6.—Gr. —, æt. 28. First attack. Contracted his disease while upon furlough. When admitted, he had three soft chancres upon the prepuce, all discharging pus; a suppurating bubo in the right groin; in the left groin a large, inflamed gland, as big as an apple. He stated that the sores followed three days after connexion, and that the disease had existed five days. Inoculation from the sores, as well as from the bubo, succeeded. Nitrate of silver was applied, and in eight days the sores all healed. Upon the sixteenth day

after the appearance of disease, below the surface of a healed sore, an induration came on, situated quite beneath the epithelium, and without any erosion. It was well defined, very hard, and typical in character, feeling like a "split pea" set in the skin. Slight excoriation took place over its surface three days afterwards. He was treated by mercurial vapour-bath and bichloride of mercury.

It occasionally, though rarely, happens that an infecting sore is preceded by a pustule, and a pustule is produced as the reaction following auto-inoculation.

Case 7.—Gr. B—, æt. 26. Admitted September 23rd. Stated that the disease followed a connexion on the 18th. (?) (Soldiers' statements upon this head are not to be depended on, as they are liable to punishment if the disease under which they suffer has been concealed; hence they will name a very recent date.)

On his admission there was a pustule upon the prepuce, seated on an inflamed base. Some pus was inoculated in the skin of the thigh, and the original pustule destroyed by potassa fusa. Upon the fifth day a pustule resulted from that inoculation, from which, again, another pustule was produced by inoculation. Both these were destroyed by caustic at this stage. When the slough separated from the prepuce, an induration was found at the seat of the original sore, which proved indolent in character. Soft ulcers, without induration, appeared at the seat of the artificial sores. The inguinal glands were symmetrically affected. He was not treated with mercury at first. About the middle of December following, he was suffering from a syphilide (squamous), with ulcerated throat.

Case 8.—*Chancre on face.*—Corporal P— presented himself at the hospital with a small ulcer upon the upper lip, close to and encroaching upon the left ala nasi. After a few days it became so unmistakeably like a Hunterian chancre that I took the man aside and told him my sus-

picions. I then learnt that about three weeks before, he went with a prostitute; but as he was suspicious of her being diseased, he abstained from connexion. At that time he was suffering from catarrh, and had a few blisters upon the upper lip (herpes labialis?). Could he have inoculated one of these? Explaining to him the probability of such having been the case, and as he wished its nature proved, I inoculated the skin of one thigh with some fluid from the ulcer. Knowing that chancres upon the face were always hard, I thought I might determine by inoculation whether it were really of the non-infecting species, modified by the tissues in which it was situated. No result, however, followed such inoculation. He was treated with mercury, and the sore healed in a month, not without the occurrence of slight swelling of the corresponding submaxillary gland. I ought to mention that he had suffered from venereal affections before, but had never had any secondaries. He has since been treated for acne indurata of the nose, nocturnal pains, alopœcia, and post-cervical engorgement. These symptoms proved very intractable, but yielded ultimately to mercury, and he is now well.

Of primary syphilis in women I know but little. The relative rarity with which the typical indurated sore is found upon the female generative organs has, however, been frequently remarked, though never explained. The syphilitic virus, falling upon the mucous membrane covering the vascular and loose glandular tissues of the vulva, seems to give rise to a product identical with what is observed upon the glans penis of the male, and, equally with it, to be often deficient in any peripheral induration.

The case of Lieut. — is given, not because it is unique, but because it was so carefully observed.

The other cases are capable of receiving one of two explanations.—1st. That they were instances of double infection. 2nd. That the inoculation of pus from an indurated and irritated sore gave rise to a pus-producing erosion, which, in time, became affected with the specific hardness.

Mr. Henry Lee has shown that the infecting chancre is not capable of auto-inoculation, unless it first be made to yield pus; and when we come to the subject of inoculation, I shall have occasion to remark upon the occasional production of an abortive form of pustule from the inoculation of other than specific pus.

It seems not at all improbable that the contact of a purulent fluid with an excoriation, during coitus, may give rise to a localized inflammation and suppuration. Case 4 appears to have been one of inflamed excoriations upon the glans, appearing early, with the subsequent evolution of an infecting sore upon the prepuce.

Case 5 was either the result of a hybrid affection, or that of a true syphilitic pus.

Case 6 was probably a hybrid affection, or double infection, upon the same spot.

Case 7 is peculiarly interesting, because the pustule was unbroken, yielding a fluid capable of inoculation; and the artificial disease was exactly such as results from the inoculation with syphilitic pus. It had an inflamed, quasi-firm base, resembling a papule.

Sores upon the integument of the sheath of the penis are commonly infecting, whatever be their appearance and character.

Secondary infection has been observed after—1st. The most superficial indolent erosion, without appreciable induration (or with this symptom of such slight degree and duration as to have escaped detection), and with little or no suppuration. 2nd. The same, with a well-defined, strictly limited, and very narrow rim of induration. 3rd. Sores, appearing as boils or spots of ecthyma, sometimes covered with a scab, discharging pus, indolent, with raised and prominent edges, honey-combed base, and large but ill-defined hardness. (I have purposely excluded that form of sore which appears as a well-defined, flattened induration, not unlike a mucous tubercle, because such is a Hunterian chancre, and I desire to avoid model cases.)

When these sores heal, they may leave little, if any, in-

duration; but a peculiarly dull, reddish brown discoloration appears at the seat of the cicatrix, which, after a time, becomes whiter in tint than the surrounding skin, and hence contrasts with it. Faint and minute radiated lines and depressions generally remain also, marking a stellate form of cicatrix.

As the situation of these sores exposes them to the irritation of the clothing, &c., they oftener inflame and suppurate than any other variety of infecting sore, and hence, I presume, it arises that their fluid is more frequently inoculable than that obtained from the indurated chancre elsewhere. At a time coinciding with the discontinuance of the police regulations affecting prostitutes in Malta, this class of sore became very frequent. From the very limited area, the small number of women in that garrison, the almost entire immunity of the troops from syphilis as a disease prior to that period, and the gregarious nature of soldiers' habits, it is probable that all were contracted from two or three sources, possibly one. The men's own statements left but little doubt also upon this head. From notes of six cases which I preserved I find that five were followed by secondaries within four months, and I heard of cases in other corps, in which the same thing was observed. These sores partook of the characters of one or other of the forms above specified. One could hardly apply the term, indurated, to any of them. An enlarged lymphatic appeared upon the dorsum of the penis in most, and in two an abscess formed at the root of the organ. The surgeon of the brigade, remarking upon the frequency and rapidity of constitutional infection, said to me that this variety of sore appeared the most certainly infecting; and yet, he added, they appear soft sores (?). We have since (1861) inoculated in a few instances from these sores, and with success in most cases. It is curious to note how frequently soldiers suffering from syphilitic infection have pointed out this part as having been the seat of chancre.

II. Inoculation, as ordinarily pursued, is not positive proof of the "specificity" of pus; *i. e.* assuming that the resulting

pustule be destroyed so soon as it appears, as is usually done. Opinions have of late been much altering upon this subject of "specificity" of inflammations. Van Roosbroeck's experiments go to prove that an ophthalmia may result from the inoculation of any pus, and that the true morbific property of that fluid depends upon the cells; for when it has been deprived of these by filtration, the remaining liquor appears innocuous. Simon, in his essay upon 'Inflammation,' (Holmes' 'System of Surgery,' vol. i), remarks—"There is ample room to question the popular impression that only specific inflammations are communicable, and much reason for suspecting it, on the contrary, to be a generic and essential property of inflammation, that its actions (or some of them) are always, in their kind, to some extent, contagious." Simon quotes from Dr. Gullie's and Sir Patrick McGregor's experience upon the occasionally contagious properties of infantile and common catarrhal ophthalmia, and cites Dr. Piringer's experiments, to the effect, that he had succeeded eighty-seven times in exciting conjunctival inflammation by the contact of an inflammatory product (pus), taken from sources the most various. That one rarely, if ever, fails with pus from a soft chancre to produce a soft ulcer, specific in character, duration, and course, is true enough, while pus from other sources often fails; and, when it succeeds, it only induces a bastard reaction. A pustule may be so produced, but the ulcer very quickly heals.

Case 9.—Br. —, a man of strumo-lymphatic aspect, was treated for gonorrhœa in the summer of 1861; sympathetic bubo followed, which suppurated. Some pus was taken from a chronic sinus, which had existed nearly five months, and the right thigh was inoculated. Upon the third day a pustule appeared, which, upon the fourth, became prominent and surrounded by an inflamed areola. At this time it was shown to a surgeon, purposely kept in ignorance of the history of its production, and he expressed no doubt about its nature. Left to itself, it healed in a few (three) days.

Case 10.—Gr. F—, æt. 23, admitted January 16th. Upon

3rd of December he was drunk, and had connexion. At the same time he sustained a fall and a slight abrasion of the left cheek; in the neighbourhood of the abrasion two pimples appeared. On admission he had three soft, suppurating sores upon the glans, and one upon the prepuce, which was inflamed. One of the pimples upon the face was covered with a scab. By fomentation the scab was removed, and a very superficial ulcer appeared, which certainly looked the counterpart of one of the sores upon the penis. I inoculated the skin of the left thigh (with two different lancets, of course) with pus from the sore on the face, and from that on the penis. The result was a pustule in either case upon the third day; a scab formed, which on the sixth day was removed from each inoculated sore. There was a punched-out, honey-combed ulcer beneath that resulting from the pus obtained from the penis, while the integument had all but healed in that produced by pus from the facial sore. No suppurating bubo followed in the groin, but the integument over the submaxillary region corresponding to the affected cheek suppurated. This could hardly have been a soft chancre upon the face (which I thought at one time). Considering that Ricord, in twenty-five years' experience, has never seen one, it would have been improbable that I should have done so; yet had I taken the result of inoculation at the third day, I might have been deceived.

En passant, I must remark how much what has been written above bears upon the views held by Mr. H. Lee, that the purulent, soft, non-infecting sore is inoculable to any extent; the plastic, infecting one, only when suppuration exists.

That there is not much difficulty in producing a soft sore from the *pus* of a hard one, and occasionally, though rarely, that an infecting sore is auto-inoculable at a very early period, are the impressions I have received from the result of inoculation in my hands.

III. It would be easy to be diffuse in illustration of con-

stitutional infection having been preceded by a suppurating bubo.

Acknowledging the intimate connexion of this with the morbid process induced by the soft sore ('chancre mou' of Ricord), and that a suppurating bubo forms no necessary part at all in the history of true syphilis, I am nevertheless certain that in army practice the exceptions to the rule are not at all uncommon.

The causes of such suppuration may be referred to one of three heads:—1st. Conditions of constitution, *e. g.* strumous and lymphatic subjects. 2nd. Accidental causes of irritation; and in the case of soldiers we have not far to go to seek these. 3rd. Exposure to multiple sources of infection, by which sores of different kinds may coexist upon the same subject.[1]

My impression is that, if the infecting sore be made to inflame and suppurate by causes of irritation, combined with dirty habits, a pus inoculation may sometimes affect the lymphatics in addition to the syphilitic one. The following cases were extracted from the records of an ordinary regiment for the past year.

[1] A certain amount of suppuration may appear in a syphilitic bubo at a later date, and be coincident with the accession of secondary symptoms, as Mr. H. Lee has pointed out, and as is illustrated in a case at a subsequent part of this paper.

Table of Cases.

Number	Name.	Age.	Date of last connexion.	Date of admission.	Seat of sores.	Character of sores.	Treatment.	Bubo.	Date of re-admission.	Character of constitutional symptoms.	Previous attacks.
1	B—	19	Sept. 1 ?	Sept. 7	Fossa glandis and corona	Irregular shape, slight discharge, firm	No mercury	Multiple and symmetrical, one suppurating profusely	Nov. 20 Dec. 30	Ulcer of tonsils; rheumatic pains Anæmia; cachexia; nocturnal pains. Cured by iodides of mercury and potassium	None.
2	M—	20	April ? (during a drunken debauch)	April 10	Prepuce	Phagedænic	Nitric acid. No mercury	Ditto	June to October	Ecthyma; suppurating cervical glands; afterwards ulcer of leg and nodes on tibia (Sept.). Mercury and Ol. Jecoris	None.
3	D—	20	?	June 7	Prepuce	Erosions superficial, with surrounding induration	Caustics. Mercury	Two suppurating buboes	Sept. 10 Nov. 20	Anæmia and rheumatic pains Pustular syphilide. Cured by mercury	None.
4	T—	19	?	Feb. 14	Prepuce	Two sores; erosions; quasi induration	Caustics. No mercury	Ditto (66 days in hospital, open groins)	Dec. 10 Dec. 16	Ulcerated tonsils; iritis (right eye) Scaly syphilide on trunk. Mercury	None.
5	S—[1]	24	?	Sept. 11	Fossa glandis and corona, with preputial reflexion	Gonorrhœa. Sore in fossa hard; on corona suppurating; on prepuce very superficial	Caustics. No mercury till induration appeared	Suppurating bubo, left groin; indurated glands, right side	Dec. 20	Ulcerated tonsils; scaly syphilide. Mercury and iron	A chancre 3 years before. A gonorrhœa 18 months before

[1] The sores upon the prepuce healed quickly (eleven days). He was discharged, and readmitted three days afterwards with sores on corona and fossa glandis. Had been drunk the whole time. These last sores became indurated.

Buboes, in connexion with infecting sores, may appear under three forms.

First, the most surely infecting; the model form of a simple and unmixed case. A symmetrical and very early, but passive, enlargement and induration of multiple inguinal glands, showing no tendency to inflame or suppurate.

Secondly, with the above, the addition of a suppurating bubo, the tissues forming the periphery of which tend to take on chronic inflammation, leading to indolence and induration.

Thirdly, in lymphatic subjects, a gland upon one side, or one such upon either side, may enlarge to a great size, inflame very slowly, and long remain a tumour, with an œdematous, boggy state of the superimposed tissues.

As has been well observed, the morbid process in the groin is but a repetition of what had existed upon the penis.

IV. Of cases of constitutional syphilitic infection following an urethral discharge, so simulating gonorrhœa as to appear clinically identical with that disease.

Cases 11 and 12.—Autumn, 1860.—Two men were admitted into hospital with gonorrhœa (?), Br. A—, and Gr. S—. At the time of this occurrence we had the power to report any case of venereal, and upon the woman being pointed out by the affected individual to the police, she was handed over for inspection and treatment. The men came to hospital within forty-eight hours of each other, and were placed in contiguous beds. Gr. S— went with the police, and pointed out the source of his contagion. Br. A— went upon the same errand to the same house, and found the woman already removed. Gr. S— told me that, to their mutual surprise, they discovered that it was the same woman in each case. Both suffered from all the symptoms of gonorrhœa, and there was no suspicion to the contrary. Br. A— had suffered from syphilis before, Gr. S— never. (This statement is made from their own words, and after a minute examination of their persons.) After remaining in hospital

a long time, Br. A— was discharged cured, and no further symptoms, so far as I could trace, appeared in his case. Gr. S—'s recovery was delayed from gleet and irritable bladder, for which instruments (Nos. 10 and 12) were used. They passed without difficulty, local tenderness, or hæmorrhage. After appearing anæmic and in ill-health, Gr. S— had sore throat (ulcerated tonsils) and a guttural voice; subsequently papules appeared on the inside of the lips and the buccal membrane, coincidently with psoriasis palmaris and "nocturnal rheumatism." The inguinal glands were slightly enlarged symmetrically. For these symptoms he took iodides of mercury and potassium, with mercurial vapour bath, by which means, after many relapses, he was cured. The case was shown to some surgeons, who, of course, suggested a concealed chancre ('chancre larvé' of Ricord). I passed sounds, and tried to discover a localized induration, without avail. If anything, perhaps the canal was firmer and more swollen to the touch than usual. Some urethral discharge was inoculated in the skin of thigh (at the time it was gleety and apparently prostatic secretion), without any effect.

The woman in this case, I learnt from the civil surgeon, had a vaginal discharge, but no primary ulcer that he could find. She was, however, suffering from acne of the face and a cutaneous syphilide.

Case 13.—Captain —, in his own words, "I believe that you doctors know very little, after all, of venereal. Here am I, never had an ulcer in my life; suffered, certainly, from gonorrhœa (at least the doctors had no doubt on that head); yet I had secondaries afterwards. Then you doctors said, 'Oh! a concealed chancre;' but the biggest sound would pass, and I have never had stricture."

Case 14.—Gr. C—, five or six days after connexion, had urethral discharge, and was admitted as suffering under "gonorrhœa" by another medical officer. After the use of

nitrate of silver injections and salines, as abortive treatment, he rapidly improved, but a slight gleet remained, for which the penis was blistered. This urethral discharge afterwards augmented in amount, and became most copious and purulent, and symptoms of cystitis set in. After having been in hospital eight weeks he came under my care. Upon the dorsum of the penis were two large, oval, indolent, indurated, raised lumps. To me they appeared chancres. The glands of both inguinal regions were passively enlarged. In answer to my questions, and without any suggestion whatever on my part as to their nature, he said, "One has existed about forty-five, and the other about forty-six days, as near as I can tell. They gradually became and remained as you now see them, and they came, I think, from the discharge getting in contact with two sore places from which the skin had been removed after blistering." In seventeen days both healed under the influence of mercury. I learn that a papular syphilide has since appeared upon the trunk. By a later report it appears that this man has again passed under treatment for marked anæmia, and ecthymatous sores upon the extremities.

Case 15.—1860.—Gr. R— was admitted with gonorrhœa (?). He remained in hospital an unusually long period, from having suffered from gleet and irritable bladder, without stricture, followed by a peculiar form of paralysis of the left lower extremity, which was supposed to be an illustration of the "reflex paralysis" described by Brown-Séquard. Continuing very anæmic, he was sent to a sanitarium for a time, without any benefit; and, pending a medical board, he was discharged from hospital, and put upon "convalescent duty." No suspicion whatever existed as to his having suffered from anything more than an ordinary, though protracted, attack of gonorrhœa, with some of the usual sequelæ. As the symptoms of local paralysis excited much interest, he was more than commonly watched. It was discovered, however, by accident, that some ecthymatous and rupial-looking sores had appeared upon the extremities.

Since that period he has suffered from a mixed cutaneous syphilide, papules upon the lips, copper-coloured stains, and indolent glandular swellings, with rheumatism and marked cachexia, for all which symptoms he has received the greatest benefit (cure?) from mercurial vapour baths, with iodides of potass and iron. In 1854, before enlistment, he had a venereal sore upon the penis.

Case 16.—A gunner caught a gonorrhœa in Gibraltar, in 1860. It proved very chronic indeed, and passed into gleet; the inguinal glands enlarged symmetrically, and one suppurated. Urethral chancre was suspected, and mercury was given him. He slowly recovered from his urethral discharge, was invalided to England, remained in Woolwich Hospital for some time, and in September, 1861, joined his brigade. Marked cachexia: numerous indurated glands in either groin, some of which inflamed, but did not suppurate. After he had remained free from any urethral discharge for six or eight months, it returned, copious in amount, and remained for six or seven days. At the same time he had sore throat (but no ulcer), nocturnal pains and lichen of the trunk, with engorgement of the post-cervical glands. No. 12 catheter passed easily, and no local sore or induration was detected.

Cases 17 and 18.—Grs. H— and R—, in January, 1859, had connexion with the same woman: both suffered from urethral discharge (simulating gonorrhœa) and chancre, as the products. Gr. R—. — Date of appearance of the disease uncertain, but he is positive that seven days elapsed before any symptom appeared. At first he had an erosion upon the inner aspect of the prepuce, which was "burnt with caustic." It became a regular Hunterian chancre, for which he remained in hospital seventy-five days. One gland in the groin suppurated. Three days after the appearance of the sore, he got urethral discharge, which continued for a month. Treated with mercury. Syphilitic rheumatism followed three months afterwards, since which time he says he has never

felt well. A slight scaly eruption appeared upon the arms at one time, which went away, and he had sore throat, which also passed off without treatment. Now (January, 1862), he is very anæmic, the glands in either groin are enlarged, and he complains of a pain, having nocturnal exacerbations, extending from the epigastrium round the left lower ribs to the left shoulder. His conjunctivæ are slightly yellow. This pain has lasted for months, and been variously treated. It was supposed to be due to dyspepsia. "In fact, sir, since that venereal I have never been the same man." He is at present being treated with iodides of iron and potash, and a mercurial vapour bath twice a week, with much improvement. Since cured.

Case 19.—Acting Bombardier —, returned from furlough. He has been in his present state seven days. At the lips of the urethra, and seen upon forcible separation of them, is a sore, non-ulcerating, raised and prominent, quasi-indurated, extending about three quarters of an inch down the tube. Upon the inner surface of the prepuce is a similar sore, discharging pus and ulcerated. Upon the integument over the pubis is a large sloughy sore, with inflamed periphery, like a boil. The inguinal glands are symmetrically affected; one is inflamed, and threatens suppuration. Upon wiping the urethral chancre free of discharge and pressing the canal, on a plane posterior to the induration, purulent fluid exudes. This man has since had secondaries.

The question of the existence of urethral chancre may be considered settled. Ricord has a plate of one such, affecting the whole course of the canal. Ricord, however, would explain every case of gonorrhœa followed by constitutional syphilis as depending upon a concealed chancre (chancre larvé). This statement rests upon the foundation, that chancre has been over and over again demonstrated within the urethra, and that the discharge has been found capable of inoculation.

Excepting the last, I have excluded cases of chancre

affecting the meatus, and visible within the canal by forcible separation of its lips; and in the preceding cases it is to be understood that the usual symptoms said to be diagnostic of concealed chancre, such as local induration, local pain or obstruction in the passage of instruments, protracted incubation between the exposure to contagion and the appearance of urethral discharge, rusty colour, gleety character, and the presence of detritus in such discharge, have been absent.

As a reviewer in the 'British and Foreign Med.-Chirurgical Review' has justly remarked, the experimental inoculation of urethral discharge by Hunter has never been thoroughly explained. Hunter, as an observer, occupies the very first rank among scientific inquirers, and there can be no doubt as to the facts recorded by him. The application and bearing of Case 14, that of Gr. C—, upon this is obvious. The prevalent doctrine (owing to the demonstration of urethral chancre by Ricord) is that, when secondary infection follows urethral discharge, it *necessarily* implies the pre-existence of an ulcer in the urethra.

One can understand how it is that in gonorrhœa an inflammation commencing near the meatus, at the seat of application of the irritant, spreads by contiguity and continuity of tissue; but how the syphilitic virus should enter and pass down a canal like the urethra, at a time coincident with an excretive act, and with the cavity (a potential one really) effaced by the physiological organism, and should become localized at a remote point, where no abrasion has existed, is very difficult of explanation.

The behaviour also of an infecting chancre within the urethra contrasts remarkably with that seated upon the exterior, in the nature and amount of the discharge. The first furnishes us with a copious, purulent excretion, the latter with a scanty, quasi-purulent or non-purulent discharge. I was unable to trace the constitutional contamination in the above cases to chancres about the mouth and face, which M. Rollet conceives to be a frequent source of the syphilitic infection.

In a translation of 'A Treatise upon Syphilitic Diseases,' by F. Swediaur, M.D., 1821, I find the following interesting remarks :—"In a word, they have maintained that there is no syphilitic or venereal gonorrhœa, properly so called, and that consequently the existence of a syphilitic blennorrhagia was only founded in theory.

"I answer to this that, though it is not very common to see blennorrhagias produce a general infection, it is not, however, very rare, especially in great towns, to see blennorrhagias followed by those symptoms."[1]

After remarking upon having seen examples of the appearance of syphilitic symptoms in consequence of a blennorrhagia, without the least appearance of chancres, and his having treated women who have had, in consequence of blennorrhagias, syphilitic symptoms, without ever having had chancres, he says that all blennorrhagias, attended with ulcers in the canal of the urethra, are often followed by symptoms of syphilis.

He enters into an elaborate theory to prove that symptoms of infection do not more frequently follow from blennorrhagias, because the syphilitic virus, applied to the urethra, excites an inflammation in it, seldom causing ulcers, the inner membrane of the canal being defended by the great quantity of mucus excited by the irritation, and this mucus diluting and carrying away the poison, as well as protecting the sides of the canal. He relates his own case to prove that if an erosion is caused by violent catheterism, an ulcer ensues, through which absorption may take place, and the system may be infected. The rarity of ulcers in the vagina of women he explains by the protection afforded by the mucus. "I know many cases where patients affected with a blennorrhagia, without any ulcer, communicated chancres, and reciprocally."

[1] Some of these cases of constitutional infection have doubtless been in reality gonorrhœal rheumatism, with an affection of the eyes (inflammation of the cornea and anterior layer of the iris). When some cutaneous disease has also appeared, these cases were and are easily mistaken. *Vide* 'Researches' of Rollet.

Again, in another part, "Sometimes in foul coition the virus is absorbed by the lymphatic vessels, and directly causes buboes; at other times it seems to pass immediately into the body, and then produces syphilitic affections, without producing any sensible effect in the parts to which it was first applied, and that without leaving the smallest trace upon the surface of the body."

I am aware that this pathology is very weak in the present day, and that much of it has been proved to be erroneous; but his suggestions as to the protective power of mucus are not entirely unsupported by facts, inasmuch as we now know that it is probably due to the presence of mucus in the stomach that its coats are protected from the solvent action of the gastric juice.

The explication and appreciation of primary syphilitic, intra-urethral disease, will be much facilitated by the following considerations.

A diffused induration of the prepuce, with balanitis, and connected with the most superficial erosions of its inner surface, as well as the most trifling erosion, without any induration, upon the glans penis, may each be the precursor of syphilitic infection.

The chancre virus appears, ordinarily at least, innocuous, if applied to integument or mucous membrane free of any abrasion.

The frequency of abrasions upon the penis, the result of various causes (such as coitus), and the frequency with which a chancre is limited to their seat, when such abrasions exist.

The contagious properties of the fluids obtained from a secondary lesion, and probably even of the blood of a person constitutionally syphilitic.

The uterine lesions furnishing leucorrhœal discharges, so commonly present in females constitutionally syphilitic.

The peculiar texture of the urethral tunics, and the modifying influences which the physiological functions of the organ must exert upon any disease affecting its mucous membrane, in its twofold aspect, the sexual and urinary;

the latter of which exclusively affects the urethra: the absence also of any abrasion, as a rule, of its lining membrane.

Lastly, some modern authors, perceiving the great difficulties attending an accurate description of the forms and appearances of a primary syphilitic lesion, have defined it simply as that lesion, initial to constitutional syphilis, which is induced by the action of the virus upon the part to which it is applied.

Bearing these considerations in mind, there would seem to be tangible grounds for the theory that, upon the one hand, a syphilitic virus, *per se*, may lodge in one of the lacunæ near the meatus, and give rise to inflammation, at first localized, then diffused, and attended with a transudation of morbid products, which may be excreted through the urethra, as well as deposited in and beneath its lining membrane, without any necessary ulceration; and, upon the other hand, that a gonorrhœal or leucorrhœal discharge may have syphilitic properties engrafted upon it, by virtue of its being obtained from the subject of a constitutional syphilitic taint, and so, that a syphilitic virus may run its course as a part and parcel of the gonorrhœal inflammation, with the exciting cause of which it is associated. Inoculation in such cases does not aid us much, as regards prognosis, or as to the use of mercury: if successful, it may be the result of either the soft, non-infecting, or the indurated, infecting sore, probably the former; if unsuccessful, it affords no direct proof against a syphilitic infection, for the indurated sore may not be followed by any reaction upon inoculation of its fluid products.

V. The "bubon d'emblée" is credited by M. Diday, who remarks upon the slow development of the tumour and its indolent character; adding that, when it suppurates, constitutional syphilis does not follow.

Case 20.—An officer, eighteen months ago, had a bubo in the right groin, which appeared without any obvious cause. After a subacute course, it suppurated, and was incised.

Aware of the nature of bubo, and that his mode of life laid him open to a suspicion as to its source, he took medical advice, not, however, believing that the disease could be syphilitic. He was perfectly certain that he had not then, nor ever had before, even the slightest sore or abrasion upon the penis, or urethral discharge, or sores upon the lips, or, indeed, upon any part of his body. "At the time the bubo appeared, I was as white and clean as a white kid glove, and neither I nor the doctor could find any sore upon me." He was assured by the medical men that it was not of syphilitic origin. Subsequently other glands enlarged in both groins, and one on the left side suppurated. About three months after this he had a "crop of boils," which was supposed to be due to impoverished blood. He consulted more than one medical man with reference to these, but was told that they were not syphilitic. One day, by accident, I saw his person, and remarked upon the "secondaries" he must have had. Indignant at this, he told me the preceding history. I doubted at first, but as mucous papules appeared about the lips, and on the cervical regions, and the post-cervical glands were enlarged, I adhered to my opinion of their syphilitic origin. He is now recovering, under mercury, from onychia of one finger, and coppery stains on the body, with psoriasis. How far does this case go to support Hunter's doctrine of physiological absorption?

VI. The question of the incubationary period of syphilis, *i. e.* the interval between the reception of the virus and the local manifestations of its action, I propose to link together with the inquiry into the value of an abortive treatment, from the manifest bearing the one has upon the other.

Case 21.—An officer, in 1857, came to me with an erosion upon the prepuce. He stated that it followed a suspicious connexion of twelve days before. He was certain that no sore appeared before that morning, as he had carefully examined himself daily in "tubbing." The inguinal glands were

not affected. Although I did not think it a specific sore, but rather an abrasion, I destroyed it with nitric acid, assuring him that he would be safe, if he had spoken the truth. After the separation of the slough, the base became indurated, and the inguinal glands also. That this officer suffered from secondaries I know to my cost. He was indignant when I hinted that he might have been deceived, or might have misled me as to the date of its appearance.

Case 22.—A serjeant came one morning in 1860, and showed me a superficial abrasion on the glans, stating that after a certain connexion he had carefully inspected himself (often twice or thrice daily), and he was sure that he had noticed a redness for the first time upon the previous evening. Nitric acid was applied, but constitutional symptoms followed, although the sore healed quickly after separation of the slough, and formed a depressed circular cicatrix upon the glans.

Case 23.—An officer, who was conversant with Ricord's views, and a thorough believer in abortive treatment, inasmuch as, he remarked, he had proved it upon his own person, noticed one day an abrasion upon the prepuce. This was ten days after the last connexion. He applied nitric acid within thirty-six hours of its first appearance, when it was no bigger than a "pin's point." Upon the following morning he again applied nitric acid. There was no induration of the sore, nor any enlargement of the inguinal glands at that time. He went upon leave. When he returned, he had an indurated, cup-shaped sore, still unhealed, with symmetrical enlargement of the inguinal glands. For these he took iodides and used mercurial vapour bath. Within two months he had an attack of jaundice and sore throat. In spite of the mercurial treatment for the primary sore, and afterwards for the icterus, syphilitic lepra appeared.

Not to be tedious in proving a point which has already been treated of by different observers, I must only remark that, if an infecting ulcer may appear after a long

period of incubation (which is said to be particularly the case with sores resulting from inoculation of the virus of a secondary lesion), it is scarcely probable that the chancre is a simple localized sore, but rather an expression of an infected state of the system, as well as a local product of the direct action of the virus upon the part to which it is applied. Collateral proof may be obtained, too, from the results of vaccination, of which I will give two cases. A soldier, after being vaccinated, was observed to apply his mouth to the part and suck it. The medical officer, desirous of seeing what effect this would have, said nothing. A regular vaccine pustule followed. An infant was vaccinated from another, and eighteen hours afterwards the vaccinated spot was touched with nitric acid. Upon revaccinating this infant five days afterwards, only a slight and very modified reaction ensued. M. Bousquet has proved also that the vaccine pustule does not appear until the organism has been modified by the vaccine virus.

Excluding all statements made by soldiers as to the period of interval between their last connexion and the appearance of the sore, as useless, I shall confine myself to the statements of officers. My opinion was lately asked by a brother medical officer upon this case, for which he stated he could positively vouch.

Case 24.—An officer went to town at a certain date, and was there exposed to contagion. One day, after taking exercise, he felt one of his groins enlarged, and at the same time he called attention to an ulcer upon the prepuce. He averred that he thought it could not be syphilis, because it began fifty-six days after his visit to London. He took a bath every morning, he said, and adhered to his statement, that it both appeared and was discovered fifty-six days after connexion. It became indurated three or four days afterwards, and the inguinal glands were symmetrically affected.

Case 25.—An officer, a man of the most thorough truthfulness, suffered from some erosions on the inner aspect of

the prepuce, which were followed by induration and balanitis. It was his first attack, and he had a timely horror of infection, and bathed, like all officers, daily. He stated, in positive terms, that the ulcers made their appearance certainly upwards of one month after the last exposure, adding that he was sure he could not have missed seeing them.

Rollet's twelve cases show that the period of incubation, following inoculation from secondary lesions, varied from nine to forty-two days, the mean being twenty-six days.

If a large number of patients be questioned as to the period of incubation, it will be found that the soft, suppurating variety of sore appears from three to eight days from the last connexion, while in the indurated, infecting variety the period is much longer. Some of the cases of long incubation may find their explanation in the fact, that there has been a prolonged contact of the virus with a healthy and unbroken surface.

Thus, Mr. Ceeley states that he has often succeeded in producing the vaccine pustule by keeping lymph in contact with the epidermis for a certain period of time, without abrasion of the cuticle.

Of course, if the individual be the subject of a double infection (*i. e.* the soft and non-infecting, with the indurated infecting sore), or if he be inoculated with a syphilitic pus, a hybrid affection may be the result of the first, or a purulent sore, followed by induration, of the second. Untrustworthy as statistics upon this point must be when taken from the statements of soldiers, the general result of my inquiries is corroborative of there being a widely different period of incubation in the two varieties of sore, and it is to this that I attribute the different effects from cauterization of venereal sores.[1]

[1] It was my intention to have given a tabular view of my experience upon this head, but I regard any statistics gained from soldiers as worthless, because many connexions may have taken place within limited periods, and because the soldier, knowing he is liable to punishment for concealment of disease, invariably asserts a recent date.

In proof that the infecting chancre is generally preceded by a long period of incubation, I may adduce Diday, who found that, while the soft sore appeared in a few days, fourteen days was the mean date for the appearance of the infecting sore. M. Chabalier found an average interval of from fifteen to eighteen days. In Rollet's case of inoculation of virus from a hard chancre upon a patient having a soft sore and bubo, no reaction took place until the eighteenth day.

Is the abortive treatment a positive guarantee against constitutional infection? Ricord thought that, if a sore were destroyed before the fifth day of its appearance, constitutional symptoms did not follow. Mr. Acton limits this to the third day. As no objective symptom appears ordinarily before such dates, by which we can diagnose the true nature of the sore, we have obviously no guarantee whatever that its character was an infecting one.

Upon the other hand, we have Langston Parker's statement, that he has destroyed a chancre two hours after its appearance, and that constitutional symptoms followed. M. Diday might be quoted to a similar effect, viz.: the insufficiency of cauterization for this end, in some papers published by him in the 'Revue Thérapeutique Médico-Chirurgicale,' and in the 'Gazette Médicale de Lyons.' Mr. Henry Lee, moreover, has proved that, if the infecting chancre be cut out, the edges of the wound take on the specific morbid process.

Whilst believing that the doctrine of the abortive treatment of infecting chancre rests upon an insecure foundation and false analogy, I would not, of course, be understood to deny the utility of cauterizing agents.—First. Because a soft chancre is undoubtedly capable of being aborted by them; and at certain stages chancres, like any other ulcers, may become indolent, weak, unhealthy, or granulating redundantly and with inflammation, and the healing may be marvellously expedited by a discriminating use of caustics. Secondly. Because I do not consider it yet absolutely proved that there is no stage at which the disease and infection can be arrested, but only that the doctrines on this head hitherto promulgated have been far too dogmatical and exclusive.

Thirdly. That, practically speaking, my own experience leads me to infer that there is a connection between the severity and duration of the primaries and the degree to which the constitution is subsequently infected. I suspect, therefore, that although the primary disease is not by any means so purely local as has been imagined, yet the virus tends to reproduce itself and germinate therefrom as a centre of infection.

In the preceding pages, the writer has drawn from his own observations, and he cannot doubt that the difficulties which he has encountered have been met by others.

The opinions and doctrines of even the best observers in syphilitic disease have been of late unsettled. In all revolutions of opinion, as one part of the truth rises, another portion often sets. We are apt to exaggerate the influence and importance of new facts, to the disparagement and neglect of the older and more established. It is as well, then, to remember that in a large majority of cases, as seen in actual practice, the doctrines of Ricord remain intact, and, guided by their teaching, we can safely discriminate and diagnose.

In the more mixed, varied, and anomalous forms we can also generally draw trustworthy conclusions, if we have regard to the *whole* of the symptoms pertaining to the infecting sore. One or other of them may be absent, but not all.

The initial lesion in constitutional syphilis is a sore, indurated, as a rule, generally solitary, involving only a part of the thickness of the tissue upon which it is seated, with sloping, and not abrupt, perpendicular edges, indolent and chronic in its nature, yielding a scanty discharge, serous or epithelio-purulent rather than purulent, not auto-inoculable, following a longer period of incubation than the non-infecting sore, and attended with an induration of multiple glands, symmetrically placed, and without tendency upon their part to suppurate.

Postscript to Sect. V, pages 433-4.

September 20th, 1862.

The following case is noteworthy in many respects, and not the least so in the following:—1st, in the primary affection being glandular disease, without any ulcer; 2ndly, in the peculiar affection of the teeth, which I have more than once noticed, and which I believe to be of syphilitic origin.

Gr. D. C—, æt. 28. Upon April 23rd, 1856, this man had connexion. Upon May 18th following he was admitted into hospital with a glandular swelling in each groin. He discovered afterwards that two soldiers had caught a venereal affection from the same woman. There were many glands affected in both groins, and one upon the left side inflamed and threatened suppuration, and was opened by caustic potash. Subsequently an abscess appeared in the right groin, and was similarly treated. No sore of any kind existed on the penis, nor was there any urethral discharge, or cicatrix, or mark on the penis. Six weeks afterwards he suffered from a red rash over the whole body, and the skin came off in scales. This exanthem was followed by the appearance of numerous pustules, and iritis of the right eye. For these symptoms he was treated by mercurials for a fortnight, but his mouth was not affected. He subsequently consumed large quantities of iodides in the Decoct. Sarsæ comp. At the end of two months he was discharged cured (?). About seven or ten days afterwards he was re-admitted with "rheumatism in all his bones," particularly the legs. The rheumatism prevented his sleeping at night. After about four months' further treatment he was discharged cured, but he has never enjoyed the health he had before these attacks.

In the beginning of 1858 his teeth began to decay in the most curious manner. A dark spot would first appear upon the front aspect of the enamel, close to the gum. The lateral incisors of the upper jaw were first affected, and disease of the remaining front teeth speedily followed. This discoloured spot became the seat of caries, and a minute circular hole resulted, situated in the middle line of the tooth, bordering upon the gum. The disease in each tooth gradually advanced from before backwards, extending laterally at the same time, and making its way in a very definite manner, until the line of caries passed through the tooth, and severed it at its junction with the fang. He has lost the upper teeth in this way. The two central incisors, however, are not quite destroyed; the disease in these has nearly severed the crown from the fang. The lower teeth have commenced to be affected in a similar manner. A line of caries has appeared upon the incisor and canine teeth, exactly at the junction of the crown and fang, and threatens their destruction.

CASE

OF

ANEURISM OF THE EXTERNAL ILIAC

AND

COMMON FEMORAL ARTERIES,

TREATED BY

DIGITAL PRESSURE.

WITH OBSERVATIONS.

BY

HENRY LEE,

ASSISTANT-SURGEON TO ST. GEORGE'S HOSPITAL, ETC.

Received June 23rd.—Read June 24th, 1862.

John Rudd, æt. 31, was admitted into St. George's Hospital on the 30th of January, 1862. He was a thin man, above the average height, with a light eye and a dilated pupil.

Three months previously he was running in order to catch a train, when his foot slipped, and he immediately experienced some pain in the left groin. He had on previous occasions felt pain in the same situation, but this he had attributed to rheumatism.

A fortnight afterwards he had a slight fall, and then his attention was directed to a swelling in the left groin, which he observed at that period "to jump." From that date he has had more or less pain in the part. Upon his admission into the hospital, the whole of the thigh was considerably

swollen, and some patches of livid discoloration existed on the outside of the limb. In the left groin was a tumour, four inches in diameter from side to side and from above downward. This extended some way above Poupart's ligament. It pulsated strongly in every part, and the sensation conveyed to the touch was as if very little solid matter were contained in the swelling.

Upon the application of the stethoscope the aneurismal bruit was heard most distinctly, and a very distinct thrill could be felt in every part of the tumour. All pulsation in the part could be arrested by pressure upon the external iliac artery, but this pressure, when long continued, gave considerable pain and inconvenience. Forcible flexion of the thigh upon the body did not stop the pulsation.

Twelve of the students of the hospital undertook, at my request, to keep up continual digital pressure upon the external iliac artery, as far as it would be borne without great inconvenience. Two gentlemen remained at the same time for four hours, and were then relieved by two others; and in this way the object was very effectually carried out. On the day following the commencement of this plan, the patient said that the pressure had given him pain, but not such as he could not readily bear. Pulse 68.

February 3rd.—The patient expressed himself as feeling a great deal better. The peculiar thrill which had been observed upon his admission could now no longer be felt; and the pulsation in the swelling was decidedly diminished. Pulse 80.

4th.—Upon measurement, the swelling appears to have decreased half an inch from above downward; some sharp pains are occasionally experienced in the part, recurring, perhaps, once or twice in an hour; when pressure is discontinued, there is now little pulsation in the swelling.

5th.—A consultation was held on the case, and it was determined that the treatment by pressure should be continued.

7th.—The pressure was discontinued for twenty-four hours. The sensation was conveyed to the touch of the swelling being much firmer and more solid than formerly.

Pulsation and a peculiar thrill now extend for three inches from above downward, and for three inches and a half from side to side of the tumour.

11th.—Last night he experienced much pain in the popliteal space. The pressure was now continued, sometimes by means of the fingers, sometimes by a very ingenious instrument made by Mr. Blaise, which answered the purpose extremely well. A comparatively slight amount of pressure now completely commanded the pulsation.

13th.—Pulse 92.

14th.—Felt sick and cold this morning, and was not so well.

17th.—The extent of the thrill and of the pulsation in each direction was found on measurement, to be two and three quarter inches.

24th.—Felt quite well in general health; had experienced a little pain in the knee and calf of the leg.

March 3rd.—Had had very little sleep for the last two nights. The leg was swollen, and he experienced pain in it. Pulse 88, full; some anxiety of countenance.

4th.—Had had a bad night from pain in the calf of the leg.

8th.—Had sat up occasionally for the last few days; the pulsation and thrill in the tumour now entirely ceased when his body was slightly inclined forward.

10th.—Complained of soreness in the groin and aching pain in the knee.

12th.—The pulsation in the tumour had now again evidently somewhat increased, and the sensation was communicated to the touch of there being less solid matter in the sac of the aneurism than formerly. A second consultation was held, regarding the propriety of tying the external iliac artery.

The patient now expressed a wish to return home and to be with his family for a few days before undergoing any further treatment. He accordingly left the hospital on the 19th. Seen at his own home on the 22nd, he was found to be suffering considerable pain along the course of the femoral artery.

31st.—There was now the smallest possible thrill in the aneurism, which was firm and unyielding.

April 5th.—The patient's constitution appeared considerably disturbed; pulse 120; complained of great pain and want of sleep. He was compelled to keep his thigh slightly flexed upon the pelvis, and was unable to straighten it. The pulsation in the tumour had completely stopped, with the exception of the slightest possible thrill, which could be distinguished, with care, at its upper part.

8th.—Pulse still 120. There was some tenderness, pain, and hardness in the course of the femoral artery, corresponding to its middle third; an increase of the swelling had taken place.

11th.—Pulse 120. The patient was unable to move his thigh without the assistance of his hands. The motions of the leg and foot were unimpaired. There was still some tenderness in the course of the femoral vessels, and pain in the tumour.

15th.—The swelling had extended round the outer and upper part of the thigh. Pulse 100.

23rd.—Pulse 120. Tumour larger; suffered occasionally considerable pain in the part. The whole leg now appeared quite powerless; the leg and foot were much swollen from œdema; the swelling around the upper part of the thigh had increased.

May 9th.—Pulse 112. The swelling now extended all round the upper part of the thigh; any attempt to straighten the thigh gave him great pain.

16th.—Had suffered a great deal of pain, principally in the course of the artery. Pulse 108.

30th.—He died, the limb having become cold on the previous day. Permission was obtained to examine the affected extremity only. This was carefully done by Dr. Dickinson.

The parts were dissected from below upward. The superficial femoral artery having been exposed, it was traced to its termination in the common femoral, and this was dissected to its termination in the remains of the sac of the

aneurism. All the coats of the artery were here seen to become suddenly dilated, and after the course of a few inches to terminate in an irregular and fimbriated margin. The greater part of the walls of the aneurismal cavity was formed by the surrounding structures, a complete separation having taken place between the upper and lower part of the artery. In the situation of the aneurism, when first observed, was a very firm coagulum of fibrin, of an oval form. This formed a sac complete in every part, with the exception of its two extremities, which lay in the direction of the natural course of the artery. The dilatation of the femoral artery into the lower part of the aneurism, and the layer of fibrin, which appeared to have answered the temporary purpose of a sac are shown in some drawings in my possession by Dr. Westmacott.

The left iliac fossa contained a large cavity filled with coagulated blood, which extended nearly as high as the umbilicus. The body of the pubes, and the femur for several inches below its lesser trochanter, presented a rough, irregular surface, from which small particles of bone could be detached with the nail. All the parts thus affected were in contact with the blood effused from the sac of the aneurism.

The superficial femoral artery was found to contain portions of decolorized fibrin, which had evidently passed into it from above. A piece of this artery was removed, and although not presenting any marks of disease to the naked eye, it was torn across by very moderate extension made with the fingers.

Remarks.—The case now related is peculiar in that a complete separation existed between the upper and lower portions of the artery which formed the aneurism. At what period this complete separation took place does not appear, but from the discoloured and swollen state of the thigh upon the patient's admission into the hospital it would appear that all the coats of the vessel had then given way.

Three principal points of interest present themselves for consideration :

1. The kind of treatment suitable to the case.

2. The effect of the digital pressure which was employed.

3. The cause of the deposit of bone on those portions of the periosteum of the pubes, and femur, which lay in contact with the effused blood.

1. It has lately been suggested in this Society that, in cases of carotid, axillary, gluteal, and iliac aneurisms, where a ligature cannot be conveniently applied to the artery between the aneurism and the heart, the sac of the aneurism may be laid open, the artery may then be found running by the side of the sac, and by a little dissection the vessel may be there exposed and tied.

An operation of this kind was attempted by Sir A. Cooper. In this instance a small incision was made into an aneurismal sac above Poupart's ligament, and, introducing his finger through the opening, Sir A. Cooper tried if it were practicable to pass a ligature round the external iliac artery within the cavity that he had opened; but the thing was found to be impossible, as, instead of the vessel, "only a chaos of broken coagula" could be perceived.

It has, however, been further suggested that, had Sir A. Cooper searched for the artery in a different part of the sac, he might have found it.

Now, an examination of the preparations of aneurisms of the larger arteries, as they exist in the museums of London, will show that the very great majority of these are of the fusiform character, formed by the dilatation of all the coats of the vessels. The cases in which the artery, of its natural size, is to be found running by the side of a portion of the sac in such a position as to admit of a ligature being applied to it, are very exceptional. It would, therefore, appear that the operation which has lately been described can be applicable to a very limited number of cases, and that, if repeated, the surgeon would in the great majority of instances find only "a chaos of broken coagula," as happened in Sir A. Cooper's operation. This would certainly have happened, had the operation of opening the sac been attempted in John Rudd's case; for not only were all the coats of the artery equally dilated at the lower part of

the aneurismal sac, but they were actually separated, and that by a very considerable interval, from the remains of the arterial coats in its upper position.

2. The digital pressure which was used in Rudd's case appears to have had the effect of causing the formation of a very complete and firm coagulum, which was found after death at the seat of the aneurism. So far the digital pressure seems to have answered its intended purpose. But the coagulum thus formed, being unsupported by the coats of the artery, gradually gave way.

At one time the pulsation in the tumour had entirely ceased. No better effect than this could have resulted from the ligature of the external iliac artery. Had this operation been performed, any coagulum which might have resulted, being unsupported by the coats of the artery, must ultimately have yielded before the arterial impulse.

3. The deposit of bone on those portions of periosteum which lay in contact with the effused blood deserves notice. In a case recorded by Dr. Donald Munro,[1] a similar circumstance is recorded, but there the affection is attributed to caries.

"The right crural artery, just as it passed over the os pubis, opened into a very large cavity, filled with a firm coagulum, larger than the head of a child three years of age, and a quantity of grumous and fluid blood, mixed with a black, very fetid matter.

"Upon emptying the sac and clearing it with a sponge and water, part of its fore and inner side appeared to be formed of the coats of the artery, and the rest of this and the other sides to be formed of muscles, cellular membranes, aponeuroses, &c. Part of the thigh-bone was bare and carious."

From the known power of the periosteum to form new bone, it is probable that both in Dr. Munro's case and in that above recorded the rough surface of bone in contact with the effused blood depended upon a fresh deposit, and not upon any disease in the bones themselves.

[1] 'Observations on Aneurism,' published by the Sydenham Society, p. 128.

REPORT OF THE COMMITTEE

APPOINTED BY THE

ROYAL MEDICAL AND CHIRURGICAL SOCIETY

TO INVESTIGATE THE SUBJECT OF

SUSPENDED ANIMATION.

Received June 10th.—Read July 1st, 1862.

Members of the Committee.—C. J. B. Williams, M.D., F.R.S.; C. E. Brown-Séquard, M.D., F.R.S.; George Harley, M.D.; W. S. Kirkes, M.D.; H. Hyde Salter, M.D., F.R.S.; J. B. Sanderson, M.D.; W. S. Savory, F.R.S.; E. H. Sieveking, M.D. (*ex officio.*)

At the first meeting of the Committee it was resolved to pursue the inquiry—

By means of experiments upon living animals.

By means of experiments upon the dead human body.

Two Sub-Committees were forthwith appointed for these purposes.

The following paper consists of two parts.

The first part contains the Report of the Sub-Committee appointed to inquire into the subject by means of experiments upon animals.

The second part contains the Report of the Sub-Committee appointed to inquire into the subject by means of experiments upon the dead body.

PART I.—*Report of the Sub-Committee appointed to investigate the subject of Suspended Animation by means of experiments upon living animals.*

In investigating anew the subject of apnœa[1] by means of experiments on the lower animals it seemed expedient to observe, in the first place, the principal phenomena of apnœa in its least complicated form, viz., when produced by simply depriving the animal of air.

The following plan of effecting this was adopted:—The animal was secured on its back, and the trachea was exposed by a single incision in the mesial line of the neck. A ligature having been passed round it, it was opened by a vertical cut, and a glass tube, as large as could be conveniently inserted, was passed into it for a short distance downwards, and firmly secured by the ligature. Through this tube, while patent, the animal breathed freely, but the supply of air could be at once completely cut off by inserting a tightly fitting cork into the upper end of the tube. It was ascertained, by separate experiments, that the tube thus plugged with the cork was perfectly air-tight.

The principal facts, then, to which attention was directed during the progress of the apnœa thus induced were—

A. The duration of the respiratory movements.

B. The duration of the heart's action.[2]

The duration of the heart's action was observed:

a. In relation to the duration of the respiratory movements.

b. In relation to the time after the stoppage of the breathing.

In reference to the solution of these questions the following experiments were performed:

[1] The term "apnœa" is here used advisedly instead of "asphyxia."

[2] The duration of the heart's action was conveniently ascertained by means of a long pin inserted through the thoracic walls into some part of the ventricles. So long as the heart continued to beat, the pin moved, and its motions were thus recorded for some time after the cardiac sounds had ceased to be audible.

Experiment 1.—A full-grown healthy dog was suddenly deprived of air by plugging the tube placed in the trachea in the manner already described. Its first struggle occurred in 25 sec.; its first respiratory effort was not recorded, its last took place at 4 min. 40 sec., and its last heart's beat at 6 min. 40 sec., or exactly 2 min. after the last respiratory effort.

Exp. 2.—A full-grown dog, treated in the same way as the above, made its first respiratory effort as early as 30 sec., and its last at 3 min. 45 sec., the last heart's beat being at 7 min., or 3 min. 30 sec. after the last respiratory effort.

Exp. 3.—A large "colly" dog was deprived of air, as before. In 10 sec. it made its first respiratory effort, its last at 3 min. 45 sec., and its heart did not cease beating till 7 min. 45 sec., thus it continued 4 min. after respiratory effort had ceased.

Exp. 4.—A full-grown, medium-sized dog, was treated as the above. Its first respiratory effort was at 35 sec., its last at 3 min. 40 sec., and its last heart's beat at 7 min. 30 sec., or 3 min. 50 sec. after respiratory effort had ceased.

Exp. 5.—A small dog, placed under the same conditions, made its first respiratory effort at 2 min. 20 sec., its last at 4 min. 5 sec., and its last heart's beat at 7 min., or 2 min. 55 sec. after the respiratory efforts ceased.

Exp. 6.—A full-grown male rabbit, treated in the same way as the dogs, made its first struggle at 30 sec. after the plugging, and its first respiratory effort at 45 sec.; its last attempt at respiration at 3 min. 20 sec., and its last heart's beat at 5 min. 30 sec. There was, therefore, an interval of 2 min. 10 sec. between the cessation of the respiratory efforts and that of the heart's action.

Exp. 7.—A full-sized female rabbit was suffocated in the same way as the last. Its first struggle occurred in 1 min., and its first respiratory effort not till 3 min. 10 sec. after the stoppage of breathing; its last respiratory effort was at 3 min. 20 sec., *i. e.*, it attempted to breathe for only 10 sec., but its heart went on beating until 9 min., or 5 min. 40 sec. after the late respiratory effort.

Exp. 8.—A full-grown male rabbit, deprived of air in the same way, made its first struggle in 35 sec.; its first respiratory effort not until 3 min. 15 sec., its last was only 20 sec. later (*i. e.*, 3 min. 35 sec.), while the last heart's beat was at 7 min., or 3 min. 25 sec. after the last respiratory effort. This rabbit attempted to breathe only 20 sec.; the rabbit operated on in Exp. 7, only 10 sec.

Exp. 9.—A full-grown female cat was deprived of air in the usual way, by plugging; its first respiration is not recorded, but its last took place as early as 1 min. 35 sec., while its heart went on beating until 7 min., an interval, therefore, of 5 min. 25 sec.

From nine experiments it is seen, that in the dog the average duration of the respiratory movements after the animal had been deprived of air, is 4 min. 5 sec., the extremes being 3 min. 30 sec. and 4 min. 40 sec. The average duration of the heart's action, on the other hand, is 7 min. 11 sec. The extremes being 6 min. 40 sec. and 7 min. 45 sec.

Lastly, these experiments lead to the belief that, on an average, the heart's action continues for 3 min. 15 sec. after the animal has ceased to make respiratory efforts. The extremes being 2 and 4 min. respectively.

In the case of the three rabbits experimented upon we find that, on an average, they ceased to make respiratory efforts in 3 min. 25 sec., that their heart's action stopped in 7 min. 10 sec.; and, consequently, that the interval between the last respiratory effort and the cessation of the heart's action, was 3 min. 45 sec.

As regards the cat, as only one experiment of this kind was performed, no average can be drawn.

The next question investigated by the Committee was—

C. The period after the simple deprivation of air, at which recovery is possible under natural circumstances, without the aid of any artificial means of resuscitation.

It may be deduced, as the concurrent and almost invariable testimony of our experiments, that the one circumstance that most of all influenced the chances of recovery in relation to *time*, was the length of time to which respiratory efforts continued to be made. The influence of this circumstance may be expressed in two ways:

1st. That a state of apnœa being maintained for a given time, the later the respiratory efforts are continued, *i. e.*, the shorter the interval between the last respiratory effort and the admission of air, the greater the chance of recovery.

2nd. That air being admitted at a given time after the last respiratory effort, the earlier the respiratory efforts cease the greater the chance of recovery; for the earlier they cease the shorter the interval between the establishment of, and the release from, the state of apnœa.

Of the relation of recovery to the duration of the heart's action it may be simply said, that under no circumstances did recovery ever occur when the heart's action, as indicated by the needle, had stopped.

The experiments made upon this point were as follows:

Exp. 10.—A full-grown dog was deprived of air in the usual manner during two minutes. It made the first respiratory effort in 10 sec. after the plug was withdrawn, and rapidly and perfectly recovered.

Exp. 11.—A medium-sized dog was deprived of air 3 min. 5 sec. and perfectly recovered, making its first free inspiration 10 sec. after the removal of the plug.

Exp. 12.—A large dog was deprived of air in the usual way during 3 min. 35 sec., and likewise perfectly recovered.

Exp. 13.—A medium-sized, but full-grown dog, was deprived of air during 3 min. 50 sec. In 10 sec. after the removal of the plug it inspired, and perfectly recovered.

Exp. 14.—A full-grown dog died after being deprived of air, in the same way as in the above cases, during 4 min. 10 sec.

In the three following experiments, already referred to, the animals all died, notwithstanding that the plug was

removed from the trachea (Exp. 2) in 4 min. 30 sec.; (Exp. 3), 4 min. 30 sec.; and (Exp. 4), 4 min. 20 sec.

These results lead to the conclusion—1st, that a dog may be deprived of air during a period of 3 min. 50 sec. and afterwards recover without the application of artificial means; and 2ndly, that a dog is not likely to recover if left to itself after having been deprived of air during a period of 4 min. 10 sec. Other experiments, which will subsequently be referred to, in connection with other questions, tend also to confirm the above fact, viz., that in dogs the doubtful interval of recovery and death lies between 3 min. 50 sec. and 4 min. 10 sec.[1]

For some time after the occlusion of the tube in the trachea, the force of the respiratory efforts was so remarkable that it was determined to adopt some means of measuring it. For this purpose, instead of the short straight tube, a long glass tube was employed, which was bent at nearly a right angle at a short distance from the extremity, which was inserted into the trachea. The other extremity was placed under mercury, so that the force of the inspiratory efforts could be measured by the height to which the column of mercury rose in the tube. The following were the results:

Exp. 15.—A medium-sized dog was treated in the above way. The respiratory efforts commenced at 2 min. 5 sec. As apnœa advanced they became more powerful, and from 3 min. 20 sec. and onwards they were very violent till 4 min. 45 sec., when they ceased. The needle showed the heart to be moving up to 8 min. This dog drew the mercury up the tube, by its violent inspiratory efforts, a height of four inches, and that height was attained in almost the last attempts at respiration, 4 min. 45 sec. after the establishment of the apnœa. On examination the lungs were found to be congested, but there were no ecchymosed spots nor blood in the tubes.

[1] The average temperature of the room in which these experiments were performed was 11° cent.

Exp. 16.—A dog of the same size was treated in the same way. The respiratory efforts, curiously enough, commenced at exactly the same time as in the last experiment, viz., 2 min. 5 sec. The mercury was drawn up in the tube a height of nearly four inches.

Exp. 17.—A large dog was treated in exactly the same way. Its most violent inspiratory efforts drew the mercury up in the tube a height of four inches.

It appears from these experiments that the inspiratory efforts under apnœa, for a dog of average size, are capable of raising a column of mercury four inches. It, moreover, appears, that the force of the efforts increases up to a certain period.

In the following experiments the great force of the inspiratory efforts was demonstrated in another way, as well as the remarkable effects which may be, under certain circumstances, thereby produced:

Exp. 18.—A guinea-pig was held so that its nose was immersed in mercury, the animal being upside down, and the nose inserted sufficiently deep in the mercury to prevent the possibility of getting any air. The respiratory efforts commenced at 35 sec. and ceased at 1 min. 57 sec. On examining the lungs they were found full of globules of mercury, which had thus been drawn up by this weak animal a distance of an inch or two, and that in spite of gravitation.

From this experiment it is easy to understand how foreign bodies may be drawn into the lungs in cases of drowning; but, still further to test this point, the following experiment was performed:

Exp. 19.—A terrier was deprived of air by plunging its head into liquid plaster of Paris, the object being to see, through the whiteness of the plaster, whether any of the fluid obtained access to the lungs. Respiratory efforts commenced at 1 min. 35 sec. and ceased at 4 min., the heart beating till 5 min. On examining the lungs the white plaster was found throughout the bronchial tubes.

These experiments, which clearly show the enormous force with which foreign substances may be drawn into the air-passages, point to the importance of this fact in the consideration of the pathology and treatment of apnœa. In any case, we must not overlook the question whether this condition has been produced under circumstances which would permit the passage of foreign matter into the interior of the lungs?

From these preliminary experiments on the effects produced by simply depriving an animal of air, the Committee passed on to the consideration of drowning. The first point to be ascertained was—"for what period can an animal be submerged and yet recover without the aid of artificial means?"

Exp. 20.—A medium-sized dog was fastened to a board, and submerged in a large bath. It was removed in 4 min., but although the heart went on acting for 4½ min. longer, it neither gasped nor moved.

Exp. 21.—A small dog, treated in the same manner, also died. Its heart pulsated for 4 min. 40 sec. after it was taken out of the water.

Exp. 22.—A third and moderately-sized dog was also treated in the same way, and for the same length of time; and although its heart went on beating 5 min. 40 sec. after its removal from the bath, it also died.

It having been thus ascertained that 4 min. drowning kills, it was determined gradually to shorten the time, in order to find out what was the limit of time at which immersion proved fatal.

Exp. 23.—A dog was bound, as before, to the board, and immersed for 3 min. 15 sec. On being taken out of the water no respiratory efforts were made; the dog was dead. Bloody froth escaped from its mouth, and its lungs were full of the same material.

Exp. 24.—The same as the above; but the dog's head was kept under water two minutes only. The dog gasped

once or twice, and then died. Lungs full of blood and watery froth.

Exp. 25.—The same, but kept under water only 1 min. The dog recovered. It was pithed an hour afterwards, and hardly any froth was found in its lungs.

Exp. 26.—The same, but kept under water 2 min. Air was obtained at intervals, however, for the first $\frac{1}{2}$ min. The dog gasped once or twice, but died.

Exp. 27.—The same. The head was immersed 1 min. 30 sec. The dog gave three gasps after being taken out, but no true respirations, and died. Quantities of bloody froth in the air-passages and lungs.

Exp. 28.—Another dog was placed in the same manner in the bath, whose temperature was 10° cent. It was removed in 1 min. 30 sec.; but, although it attempted to make some imperfect respirations after being taken out, it died.

Exp. 29.—A similar sized dog was treated in exactly the same way, and submerged for the same time, 1 min. 30 sec. It gave one cry on being taken out of the water, and made six or seven imperfect respirations, but soon died.

Having seen that a dog lives after being submerged 1 min. and dies after being submerged 1 min. 30 sec., another experiment was performed.

Exp. 30.—A large dog was submerged 1 min. 15 sec. On being removed it perfectly and almost immediately recovered.

Thus then the remarkable fact appeared, that whereas in simple apnœa, recovery may be possible after the deprivation of air for 3 min. 50 sec. (Exp. 13), and subsequent experiments showed that a dog simply deprived of air almost certainly recovered after 4 min.; $1\frac{1}{2}$ min. immersion in water suffices to destroy life.

Now to what is this striking difference due? With reference to this question the following experiments were performed.

It was resolved, in the first place, to eliminate the element of exhaustion produced by the struggling; it was thought that possibly the violent struggles of the animal to gain

breath, when its limbs were confined, might exhaust it, and hasten the catastrophe.

Exp. 31.—A cat was placed in a cage, and the cage plunged under water. The animal's limbs were at perfect liberty, and there were no violent struggles. After 2 min. the cage, with the cat in it, was taken out, and the cat was dead.

Exp. 32.—A dog was treated in the same way, but the cage was kept submerged in the water only $1\frac{1}{2}$ min. The dog died. There had been no struggle.

Thus it was seen that struggling had nothing to do with the early fatal result, as it happened equally soon when there were no struggles.

It was next determined to eliminate the element of cold, and for that purpose the following five experiments were performed, in which cold was applied to no part of the surface except the animal's head.

Exp. 33.—A small dog was held inverted, and its head alone dipped in the bath, just deep enough to prevent its getting air. Its head was kept under water exactly 2 min. On being released it gasped for half a minute, and died.

Exp. 34.—A large dog was treated in exactly the same way, and for the same time. On its head being released, it gasped for three quarters of a minute, and died.

Exp. 35.—A small dog was treated in the same way, its head being carefully held by the ears so as to exercise no pressure on the neck. At 2 min. its head was released. It made a few feeble respiratory efforts, and died.

Exp. 36.—A large dog was treated in the same way, for the same time, and with precisely similar results; only it gasped for as long as 1 min. 40 sec. after release from the bath. At 3 min. it was evidently dead.

Exp. 37.—The same experiment was performed upon a medium-sized dog: 2 min., as before, was the time the head was kept submerged. The result was the same, death.

Still further to clear up this question it was determined to place two dogs under precisely similar circumstances, with

the single exception that in the one case the free access of water to the lungs should be permitted, and in the other case prevented. The following were the experiments:

Exp. 38.—Two dogs of the same size were fastened to the same plank, and submerged at the same moment, but one of them had previously had its windpipe plugged in the usual way, and the other had not. At 2 min. they were taken out together; the one that had been plugged at once recovered, the other died.

Exp. 39.—The above was repeated, the dogs being kept under water 2 min. The dog that had been plugged got up in 4 min. comparatively well, while the other, though gasping when taken out, in 4 min. was dead.

These experiments satisfactorily show that the difference between apnœa produced by plugging and that by drowning is not due to submersion, to depression of temperature, or to struggles, seeing that the two animals are placed under similar conditions, with this most important exception—that in the one case a free passage of air out of the lungs, and of water into them is permitted; in the other the exit of air and the entrance of water are prevented.

There can be no doubt that both these circumstances are concerned in producing the difference in the results of the two experiments; but that the fact that animals do not recover after so short a period of immersion is mainly due to the entrance of water, and the effects thereby produced, seem to be established by the following considerations:

The condition of the lungs, as revealed by the post-mortem examination. On examining the lungs of the animals deprived of air by plugging the trachea, they were found simply congested; but in the animals drowned not only was the congestion much more intense, accompanied with ecchymosed points on the surface, and in the substance of the lung, but the air-tubes were completely choked up with a sanious foam, consisting of blood, water, and mucus churned up with the air in the lungs, by the respiratory efforts of the animal. The lung substance, too, appeared to be saturated and

sodden with water, which stained slightly with blood, poured out at any point where a section was made. Whether this frothy water, which thus poured out from the cut surfaces, escaped only from minute tubes, or had any of it reached the ultimate air-cells, and was poured out from the spongy surface itself, could not well be determined; it certainly escaped from parts of the cut surface not occupied by air-tubes of visible size. The lung thus sodden with water was heavy (though it floated), doughy, pitted on pressure, and was incapable of collapsing. It is not difficult to understand how by such infarction of the tubes, air is debarred from reaching the pulmonary cells; indeed, the inability of the lungs to collapse on opening the chest is a proof of the obstruction which the froth occupying the air-tubes offers to the transit of air.

The gasping but fruitless attempts at inspiration in drowned animals, after removal from the water, contrast strongly with the fact that an inspiratory effort after the removal of the plug in simple apnœa, is almost invariably successful and followed by recovery, and accords with the different conditions discovered by a post-mortem examination.

The conclusion thus arrived at is confirmed by the great length of time that the heart continues to act after submersion.

The entire dependence of the early fatal issue, in apnœa, by drowning, upon the patulous condition of the windpipe, and its results, was strikingly shown in another way by the following experiments.

Exp. 40.—A strong dog had its windpipe plugged in the usual manner, and was then drowned, that is, submerged in water, for 4 min.; three quarters of a min. after its release it breathed, and in 4 min. had fully recovered.

Exp. 41.—A large dog was treated in exactly the same way, and with exactly the same result, perfect and immediate recovery after 4 min. submersion.

Exp. 42.—A medium-sized dog was plugged and submerged, just as the above. The result was just the same; after 4 min., perfect recovery.

Here, then, are three cases of recovery after 4 min. apnœa, in which the dogs were in every respect under the conditions of drowned animals, except that their windpipes were plugged. These experiments form an admirable contrast to the cases of mere drowning without plugging.

Seeing that the entrance of water into the lungs, and the formation of foam by its admixture with the air in the bronchial tubes, together with the mucus of their surface, is due to the violent respiratory efforts during the first minute of submersion, it appeared, that if these efforts could by any means be diminished, the result might be somewhat modified. With the view of testing the validity of this opinion, the following experiments were performed.

Exp. 43.—A medium-sized dog was rendered insensible by chloroform, and drowned. It was kept in the water for $2\frac{1}{2}$ min. Its respiratory efforts were by no means violent, and were in this respect in strong contrast with those of the unchloroformed dogs. At first the dog appeared as if he would recover, but he soon failed in his respiratory efforts, and died.

Exp. 44.—The same experiment as the last was repeated, except that instead of the apnœa being kept up for $2\frac{1}{2}$ min., the dog was kept submerged only for 2 min. The same things were observed as in the previous dog, and the result was perfect recovery.

Exp. 45.—The same experiment was again repeated on a small dog, and one dog having died at $2\frac{1}{2}$ min., and the other recovered at 2 min., it was determined to try the intermediate time, and keep this dog submerged for 2 min. 15 sec. The dog recovered immediately and completely.

Hence it was seen that while a dog submerged for 2 min. without being previously chloroformed dies, a dog previously chloroformed may be submerged for 2 min. 15 sec., and recover, and that by simply depriving the animal of the power of making violent respiratory efforts the period during which submersion may be continued, and yet recovery follow, is at once prolonged. The value and conclusiveness of

these chloroform experiments, as showing the essential connection between the early fatal result in drowned animals, and the violent inspiratory efforts that fill the lungs with water, need not be pointed out.

Treatment of Apnœa.

Various means of resuscitation were employed in many of the experiments performed by the Committee, and with variable results.

Artificial Respiration.

Artificial respiration was practised by the following methods, and sometimes, as the experiments show, with beneficial results.

Exp. 46.—A full-grown small dog was deprived of air by plugging a pipe in the trachea, and 1 min. after its last respiration, which was at 5 min. 50 sec., the plug was withdrawn, and artificial respiration by interrupted pressure on the chest established. The dog died.

Exp. 47.—A full-sized dog was drowned for 1 min. 30 sec. Immediately on being taken from the water, artificial respiration by interrupted pressure of the ribs was practised and kept up for some time, but no symptoms of resuscitation appeared.

Exp. 48.—A strong dog was submerged for 2 min. Immediately on its release artificial respiration by pressure was commenced, and was kept up for 9 min. 30 sec., but there were no appearances of life.

Exp. 49.—A very strong large dog was deprived of air by plugging its trachea, and 1 min. after its last respiration, which was at 5 min. 10 sec., the instrument invented by Dr. Marcet for artificial respiration was employed, but the heart stopped soon after, and the dog was dead. This, however, was a very unfavorable case, as apnœa had been established for 6 min. 10 sec.

Exp. 50.—A medium-sized dog was treated just as the last. Its last effort at respiration occurred at 4 min. 55 sec. Half a minute after this, Dr. Marcet's apparatus was

applied, and in one half minute more the dog made a natural respiration, and recovered.

In another experiment, already mentioned (Exp. 13), the dog recovered on the use of Dr. Marcet's apparatus 1 min. 10 sec. after its last respiration.

Exp. 51.—The same dog as had been previously used in Exp. 13, was again deprived of air as before, and on the use of Dr. Marcet's instrument, 1 min. after respiration had ceased, it again recovered.

Exp. 52.—A full-sized dog was drowned for 2 min. Artificial respiration by means of Dr. Marcet's apparatus was commenced 40 sec. after its release, and kept up for 9 min. No recovery.

No definite conclusion concerning the relative value of the various methods of artificial respiration can be drawn from these experiments.

For this subject the Committee would refer to the 'Report of the Experiments upon the Dead Human Body.'

The Committee are not prepared to recommend the use of any particular apparatus in the employment of artificial respiration, for the following reasons:

1st. The efficiency of the simpler means (see second portion of the Report).

2nd. The loss of time (a consideration second to none in importance) necessarily consumed in the adjustment of any apparatus whatever.

3rd.—The impracticability of having it at hand at the time when it is likely to prove of any value whatever.

Many other methods of resuscitation, which have been recommended, were practised; including actual cautery, venesection, cold-splash, alternate application of hot and cold water, galvanism, puncture of the diaphragm.

The following were the results:

Actual Cautery.

Exp. 53.—A middle-sized dog was deprived of air in the usual way, by plugging the trachea, 1 min. after its last respiration the actual cautery was applied by drawing the

cautery.iron, heated to a white heat, in a gas jet, quickly over different parts of its chest and back. The dog died, or rather there were no symptoms of its recovery.

Exp. 54.—A large dog was treated in precisely the same way, with the same results.

Exp. 55.—A young dog was treated in the same way as the others, and the cautery applied 1 min. after its last respiration. In 20 min. 30 sec. the needle marking the heart's movement had stopped.

Exp. 56.—A guinea-pig was drowned; 1 min. after its last respiratory effort the actual cautery was applied. There was no recovery, and the heart stopped in 1 min. 55 sec.

Exp. 57.—Another guinea-pig was treated in the same way, with the same result.

In the above five experiments, then, in all of which the actual cautery was applied 1 min. after the last respiratory effort, death was the invariable result.

Venesection.

Venesection was practised in the three following experiments:

Exp. 58.—A middle-sized dog was suffocated in the usual way, by plugging its windpipe, and made its last respiratory effort at 2 min. 45 sec. Three quarters of a minute after this its jugular vein was opened. The action of the heart for a time revived, but the dog died.

Exp. 59.—A dog was submerged for 1 min. 30 sec. Immediately on being taken from the water his jugular was opened. No recovery.

Exp. 60.—A similar dog was submerged for 2 min. One minute after its removal its jugular was opened. It gasped at intervals, but died.

Cold Splash and Douche.

Exp. 61.—A full-grown dog had its windpipe plugged, and made its last respiratory effort at 3 min. 35 sec. One minute after this the plug was drawn, and the cold splash applied. The dog died.

Exp. 62.—A full-sized dog was deprived of air, in the same way as the last. At 3 min. 40 sec. it made its last respiratory effort. In 1 min. after this, that is 4 min. 40 sec. after the establishment of the apnœa, the plug was drawn, and the dog plunged in cold water. In 35 sec. this was repeated; 1 min. 20 sec. later the dog breathed, and perfectly recovered.

Exp. 63.—A small dog was treated in the same way as the last. 1 min. after its last respiration the cold douche was applied, and was repeated twice at intervals of 25 sec. The heart beat up to 9 min. 30 sec., but the dog died.

Exp. 64.—A medium-sized dog was treated in the same way, and with the same result, death.

Hot Douche alternated with Cold.

Exp. 65.—A young dog had its trachea plugged in the usual way. At 3 min. 15 sec. it made its last respiratory effort; 1 min. later the plug was drawn, and the hot douche, alternated with cold, vigorously applied; 45 sec. later the dog made a voluntary respiration, and perfectly recovered.

Exp. 66.—A medium-sized dog was in every respect treated the same way. At exactly the same time after the commencement of the hot and cold douche, that is, 45 sec., the dog voluntarily respired, and, like the other, recovered.

Exp. 67.—This experiment was the counterpart of the last two, except that the respiratory efforts were prolonged to 4 min. 55 sec. On the application of the hot and cold douche there were no respirations, and the dog died.

Galvanism.

Galvanism, without other means, was tried in the following seven experiments:

Exp. 68.—A dog of medium size had his trachea plugged. 1 min. after the last respiration the plug was removed, and galvanism applied. There was no favorable result. The dog died.

Exp. 69.—A dog was treated in just the same way as the last, but the plug was withdrawn and the galvanism

applied three quarters of a minute after its last respiratory effort. 1 minute 10 seconds later the dog made a natural respiration, and soon recovered.

Exp. 70.—A similar dog, treated in the same way as the last, made its last respiratory effort at 5 min. 5 sec. In three quarters of a minute the plug was drawn, and galvanism applied. But the dog died; indeed the movements of the needle indicating the heart's action seemed to have stopped before the galvanism was commenced.

Exp. 71.—The same dog as had been used in Exp. 12, and had then recovered, was deprived of air by plugging the trachea. Three quarters of a minute after its last respiratory effort, which was at 4 min. 55 sec., the plug was drawn, and galvanism applied; but there were no symptoms of resuscitation.

Exp. 72.—A dog of medium size was suffocated in the same way as the last. At 3 min. 15 sec. it made its last respiratory effort, and three quarters of a minute afterwards the plug was drawn, and galvanism applied. Two minutes later the dog made a natural respiration, and recovered.

Exp. 73.—A small young dog was deprived of air in the usual way. Its last respiratory effort was at 3 min. 50 sec.; 1 min. later the plug was drawn, and galvanism applied, and kept up for 3 min. No favorable result.

Exp. 74.—A full-grown dog, of medium size, was deprived of air in the same way as the others. It made its last respiratory effort at 4 min. 10 sec., 1 min. after which the plug was drawn, and galvanism commenced. It was kept up for 3 min. 30 sec.; the heart was then found to have stopped, and the dog to be dead.

Puncture of Diaphragm.

Exp. 75.—A dog of middle size was choked by plugging the windpipe, and made its last effort at respiration at 3 min. 25 sec.; 1 min. later its diaphragm was punctured by a needle; an immediate natural respiration was the result, and the dog recovered.

Exp. 76.—The dog which had recovered in Exp. 72, was

again deprived of air by plugging its windpipe; 1 min. after its last respiratory effort the diaphragm was punctured; a minute later galvanism was applied. There was, however, no result. The dog died.

Exp. 77.—The dog which had recovered in Exp. 75, and was now quite lively, was placed again in the same condition by plugging its windpipe. 1 min. later the plug was drawn and the diaphragm punctured. The puncture was instantly followed by respiratory movements, and the dog, for the second time, perfectly recovered.

Exp. 78.—A dog deprived of air, in the same way as the rest, and in which the last respiratory effort occurred at 4 min. 40 sec. had the plug withdrawn, the diaphragm punctured, and galvanism applied 1 min. later. There was no result.

Although some of the above means were occasionally of manifest advantage, no one was of such unequivocal efficacy, in a sufficient number of cases, as to warrant the Committee in specially recommending its adoption.

PART II.—*Report of the Sub-Committee appointed to investigate the subject of Suspended Animation by means of Experiments on the dead Human Body.*

Experiments on the Dead Subject, made with a view to determine the value of the various methods which have been employed for alternately Compressing and Expanding the Cavity of the Chest, in such a manner as to imitate the natural movements of the Thoracic walls in Breathing.

The following methods have been investigated:

1. Pressure exerted by the hands on the anterior wall of the thorax, the body being in the prone posture; such pressure has for its object to expel a portion of the air con-

tained in the chest; on relaxing the pressure the chest expands, and air enters.

2. The postural, or so-called ready method, described by Dr. Marshall Hall, which consists essentially in "turning the body gently on the side and a little beyond, and then briskly on the face, alternately;" and in making pressure along the back of the chest each time the body is brought into the prone position.

3. The method of Dr. Silvester, in which the action of the pectoral and other muscles passing from the shoulders to the parietes of the chest in deep inspiration is imitated. An inspiratory effect is produced by extending the arms upwards by the sides of the head; on restoring them to their original position by the side of the body the expanded walls are allowed to resume their previous state, and expiration takes place, the quantity of air expelled being in proportion to that which had been previously inspired.

In carrying out their inquiries the Sub-Committee have availed themselves of such opportunities as the hospitals of the metropolis have afforded. Great difficulty has been met with in obtaining appropriate subjects for experiment, for in the greater number of patients dying in hospitals the thoracic viscera are more or less diseased. The lungs are frequently œdematous, tubercular, pneumonic, or compressed by pleural or pericardial effusion, or enlarged heart. The trachea or bronchial tubes are often obstructed by large quantities of mucus, or by fluids which may have entered them from the mouth or stomach immediately before death. It appeared to be essential that the respiratory passages should be freely pervious and the lungs in a moderately healthy condition; and very desirable that the ribs, costal cartilages, and sternum, should be freely mobile, instead of being comparatively rigid either by age, disease, or rigor mortis. The majority of the subjects were found, for some of the reasons stated above, to be unfit for the purposes in view; so that the results which were obtained from them were inapplicable to the inquiry.

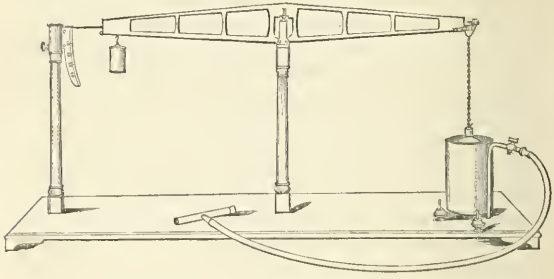
Method of investigation.

Up to the present time no attempt has been made to determine, by actual measurement, the quantity of air alternately introduced into the respiratory cavity and expelled therefrom by the several mechanical expedients above enumerated. Dr. Silvester is content with stating that in the employment of his method, an effect is produced ten times as great as can be obtained from that of Dr. Marshall Hall, but his work contains no statement as to the quantity of air exchanged. The treatise of Dr. Marshall Hall affords no definite information as to the results of experiments made with an instrument of measurement therein described. (See 'Prone and Postural Respiration,' p. 63.)

It being necessary to measure the flow of air in and out of the respiratory cavity under conditions of pressure closely resembling those which exist in natural respiration, no means of measurement could be used which in its working would offer any appreciable resistance to the passage of air. With this consideration in view an instrument of the following kind was constructed. (See Fig. p. 470.)

A cylinder of glass, three inches in diameter, is suspended by its closed upper end in a suitable cylindrical receiver of larger dimensions, half filled with water, in the same manner as the cylinder of an ordinary spirometer. Instead, however, of being supported as in the spirometer by an arrangement of pulleys, the cylinder is connected by a chain with one end of a scale-beam which bears at its opposite end a counterpoise. The weight of the counterpoise is equal to the weight of the cylinder when its open mouth is plunged to a given depth in the water of the receiver, care being taken that the air included in the cylinder shall communicate freely with the atmosphere. The scale-beam is supported at its centre of gravity by a knife edge, resting on a steel surface, so as to secure perfect freedom of movement. With the same view, the end of the beam on which the cylinder rests is furnished with a knife edge, on which the bearing of

the latter is supported; the other end is prolonged into a needle or pointer, the movements of which are indicated on a graduated brass scale or circle, and the whole is so adjusted as regards the quantity of water in the receiver, that the beam shall be horizontal, in which position its index points to 0 of the graduation. Air enters or escapes from the measuring cylinder by a U-shaped tube, one leg of which is in the axis of the receiver, its open end rising above the level of the water; the other outside of the receiver is furnished with a stop-cock, and connected with the respiratory cavity when the apparatus is in action. To effect this connection, a T-shaped tube of gutta-percha is employed. The cross-bar, about seven tenths of an inch in width, is adapted to the trachea by one of its ends; the stem of the T is connected with the stop-cock by a length of flexible tube.



In such an instrument it is obvious that the quantity of air contained in the cylinder is indicated by the position of the beam, and consequently of the pointer. The graduation of the scale was effected by introducing measured quantities of air through the stop-cock, and marking off the successive positions of the needle, the apparatus having been first so adjusted as to stand at zero at the commencement of the operation. The numbers on the scale express in cubic inches the quantity of air in excess of the quantity at first

contained. The measurement is subject to an error, arising from the fact that the weight of the cylinder varies inversely as the proportion of it which is immersed in water, but the amount of this error is so inconsiderable that it may be entirely disregarded. The receiver was furnished with a water manometer, or pressure guage, by which the effects of these differences of weight were at all times shown; in no position of the apparatus did the depression of the column exceed four tenths of an inch, so that the error could in no instance amount to more than 1000th part of the whole volume of air contained in the apparatus and in the thorax together.

In all the experiments, the measuring apparatus was directly connected with the trachea, the object in view being to determine the changes of capacity of the respiratory cavity under the most simple conditions possible.

Experiments on the dead body, to determine the best method of introducing air into the lungs.

February 24th, 1862.—At St. Bartholomew's Hospital.

Subject I.—A middle-aged, well-formed man, dead several days; commencing decomposition; chest natural in form, and normally resonant on percussion, except in the right lower lateral region, where it was dull.

Observation 1.—Dr. Silvester's method. Body lying on back, head hanging a little over the edge of the table. Gradual extension and elevation of both arms was attended by the introduction of 17 cubic inches of air into the lungs. On replacing the arms to the side, 15 cubic inches of air were expelled from the lungs.

Obs. 2.—Repetition of the above. On extension of arms 18 cubic inches were inspired, on restoration of arms to side 16½ cubic inches were expired.

Obs. 3.—Repetition of observations 1 and 2. On extension of arms 16 cubic inches inspired. On depression of

arms 14½ cubic inches expired. These observations were again repeated several times, and with very similar results.

Obs. 4.—To show effect of pressure upon the sternum. Gradual and moderate pressure with the hand upon the lower part of the sternum expelled 15 cubic inches of air. Relaxation of the pressure was followed by the introduction of 9 cubic inches of air.

Obs. 5.—To show effect of Dr. Silvester's method combined with pressure on the sternum. On extension of the arms 17½ cubic inches of air were inspired. On depression of the arms 15 cubic inches of air were expired. On making pressure upon the middle of the sternum, 8 additional cubic inches were expelled, *i. e.*, 23 cubic inches altogether.

Obs. 6.—Repetition of Silvester's method and pressure. On extension of arms 17 cubic inches were inspired. On depression of arms 13 cubic inches were expired. On making pressure upon the lower part of the sternum 11 additional cubic inches were expelled, *i. e.*, 24 cubic inches altogether.

Obs. 7.—To show effect of pressure on lower part of sternum alone. This caused an expulsion of 10 cubic inches of air.

Obs. 8.—To show effect of pressure with the hands applied simultaneously to both sides of the chest. This caused an expulsion of 8 cubic inches of air.

In each of the above experiments to show the influence of pressure, a block was placed under the shoulders of the subject. The degree of pressure exerted was moderate, and not more than might be applied to the living body without injury.

Obs. 9.—Dr. Marshall Hall's method. At the commencement of the observation, the body was lying on the back. On turning it to the left side, 2½ cubic inches of air were inspired. On placing it on the abdomen, 7 cubic inches of air were expired. On restoring the body to the supine posture, very little interchange of air took place.

On repeating the other methods with this body, no uniform or definite results were now obtained; it was thought that

some obstruction to the air-passages, from fluid or otherwise, had been caused by the postural change in the Marshall Hall method. No further observations, therefore, were made with this subject.

Subject II.—Same day and place. The body of an apparently healthy young man, who had been killed by concussion of the brain, caused by falling from a cab; dead about three days; no signs of commencing decomposition. No evidence of fractured ribs, or of any external injury. Good resonance on percussion over the front and sides of the thorax.

Obs. 10.—Marshall Hall method. Body lying supine at the commencement of the observation. When turned on to the side, there was no indication of an interchange of air, the index remaining motionless. When the body was turned to the prone posture, $7\frac{1}{2}$ cubic inches of air were expelled. When the body was restored to the supine posture, 2 cubic inches were found to have been inspired during the movement from the face to the back. The observation was repeated, the body being rendered prone, and then restored to the supine posture, but no interchange of air at all was now indicated. The small amount of air moved in the first of these two observations, and the negative result of the last, led to a careful inspection of the apparatus, to see if it was in fault; but it was found to be in perfect working order, as the results of the succeeding observations will show.

Obs. 11.—To show effect of pressure on the lower part of the sternum. Moderate pressure expelled 10 cubic inches of air. Relaxation of the pressure was followed by the introduction of the same amount of air, namely, 10 cubic inches.

Obs. 12.—Pressure on the middle of the sternum expelled 8 cubic inches of air, and a like amount of 8 cubic inches was inspired on relaxing the pressure. The last two observations were repeated several times, and were uniformly attended with the same result, showing that 2 more cubic inches of air were interchanged during lower than during middle sternal pressure and relaxation.

Obs. 13.—To show effect of middle and lower sternal pressure combined. The result was the same as when lower sternal pressure alone was practised, namely, an expulsion of 10 cubic inches of air, followed by the inspiration of a like amount of 10 cubic inches on relaxing the pressure.

Obs. 14.—To show effect of lateral pressure with both hands. Pressure on both sides simultaneously applied, expelled 11 cubic inches of air; a corresponding amount of 11 cubic inches were inspired on removing the pressure. This pressure was made rather firmly.

Obs. 15.—Dr. Silvester's method. On elevating the arms 18 cubic inches of air were inspired. On replacing the arms to the side, 16 cubic inches were expired. On repeating this observation, 14 cubic inches were inspired; 11 expired.

Obs. 16.—To show effect again of sternal pressure and relaxation. This process was repeated several times in succession, and with the constant result of from 8 to 10 cubic inches of air being interchanged each time. In this observation, ordinary respiratory murmur was distinctly heard on applying the stethoscope to the chest during the interchange of the air.

Obs. 17.—Dr. Silvester's method. This was again repeated, and an average result obtained, that about 17 cubic inches of air entered and left the lungs each time.

Obs. 18.—To show effect of pressure by means of a broad bandage encircling the chest. This was practised several times, and showed, as an average result, that from 8 to 10 cubic inches of air were expelled by the pressure, and re-entered on relaxing the pressure.

March 19th, 1862.—At St. Mary's Hospital.

Subject III.—A middle-aged thin man, dead about three days, no decided signs of decomposition; rigor mortis strongly marked; chest tolerably resonant on percussion, except over lower half of right side, where it was dull.

Obs. 1.—Dr. Silvester's method. On gradually raising the arms, 24 cubic inches of air were inspired. On replacing the arms to the side, 23 cubic inches were expelled.

Obs. 2.—Repetition of the above. On raising the arms 26·6 cubic inches were inspired. On replacing the arms 27·8 cubic inches were expired.

Obs. 3.—Repetition of the above. On raising the arms 25·4 cubic inches were inspired. On replacing the arms 25·4 cubic inches were expired.

Obs. 4.—On laying a $5\frac{1}{2}$ lb. weight upon the lower part of the sternum 0·35 of a cubic inch of air was expelled.

Obs. 5.—The last observation was repeated several times, with the view of determining how much air could be expelled by that amount of sternal pressure; the average result was 0·25 of a cubic inch.

Obs. 6.—On making moderate pressure with the hands over the lower part of the sternum 12·1 cubic inches were expelled. On relaxing the pressure, 8·4 cubic inches were inspired.

Obs. 7.—On repeating the last observation 11 cubic inches were expelled by the pressure, 9·7 cubic inches inspired on withdrawing it.

Obs. 8.—Another repetition of the same. 11 cubic inches were expelled by the pressure; 11 cubic inches were inspired on relaxing it.

These observations, showing the influence of moderate hand pressure upon the lower part of the sternum, were repeated several times, and gave the same general result, namely, that from 10 to 12 cubic inches of air were interchanged by the alternate pressure and relaxation.

Obs. 9.—Dr. Silvester's method repeated. On extension of the arms 29 cubic inches of air were inspired. On replacement of the arms to the sides, 26·6 cubic inches were expelled.

Obs. 10.—Repetition of last observation; results the same.

Obs. 11.—Another repetition. Extension of arms caused 29 cubic inches to be inspired. Replacement of arms caused a corresponding amount of 29 cubic inches to be expired.

Obs. 12.—Results not reliable.

Obs. 13.—To show the effect of Dr. Silvester's method when combined with pressure on the sternum. On raising the arms, 29 cubic inches of air were inspired. On replacing them, 29 cubic inches were expired. On adding sternal pressure, 12 more cubic inches were expelled, giving a total of 41 cubic inches interchanged.

Obs. 14.—To determine the quantity of air which could be introduced into the lungs by elevation of the lower ribs, so as to imitate the action of the diaphragm. On raising the lower ribs on the two sides simultaneously, by means of the hands, and then allowing them to subside, it was found that about 5 cubic inches of air were thus interchanged.

Obs. 15.—Repetition of the last observation: results the same.

Obs. 16.—To determine the quantity of air interchanged by alternate compression and relaxation of the sides of the chest. On pressing both sides simultaneously, with the hands, and then relaxing the pressure, it was found that about 5·3 cubic inches of air were interchanged. On applying stronger pressure, 7·3 cubic inches were interchanged.

Obs. 17.—Dr. Silvester's method was again tried, and with results similar to those last recorded.

Obs. 18.—A failure.

Obs. 19.—A failure.

Obs. 20.—Dr. Marshall Hall's method. When the body was turned from the supine posture to one side, 7·2 cubic inches of air were inspired. On turning the body on the face, 7·2 cubic inches were expelled. On making pressure over the back, 8·5 additional cubic inches were expelled, giving a total of 15·7 cubic inches of air expelled by this method.

Obs. 21.—The last observation was repeated, but the amount of air now interchanged was very much less, being scarcely 2 cubic inches during simple rotation. Pressure on the back, however, when the body was prone, expelled between 7 and 8 cubic inches more.

Obs. 22.—Another repetition of the same method: results the same as in Obs. 21.

Obs. 23.—Dr. Silvester's method again tried. On raising the arms, 44 cubic inches of air were inspired. On replacing the arms, 38·6 cubic inches were expired.

Obs. 24.—Repetition of the last observation. Results about the same, proving an interchange of nearly 40 cubic inches of air by this method.

Obs. 25.—Another repetition of this method. Extension of arms caused 38·6 cubic inches to be inspired. Replacement of arms was attended by the expulsion of a like amount of 38·6 cubic inches.

During the last few experiments the rigor mortis had been greatly overcome, and the upward movement of the arms could be practised much more readily than at first, and much as it would be during life or suspended animation.

March 20th, 1862.—At St. Mary's Hospital.

Subject IIIa.—The same body as in the last observation.

Obs. 1 and 2.—Dr. Silvester's method. Extension of arms introduced 41 cubic inches of air into the lungs. Replacement of arms to side caused 41 cubic inches to be expelled. Pressure on the sternum expelled 10 additional cubic inches of air, giving a total expulsion of 51 cubic inches. On relaxing the sternal pressure, 7 cubic inches were inspired.

Obs. 3 and 4.—Repetition of last. On elevation of arms, 42 cubic inches of air introduced. On replacement, 42 cubic inches of air expired. On sternal pressure, 10 additional cubic inches expelled, giving a total of 52 cubic inches expelled. On relaxing the sternal pressure, 7 cubic inches were again inspired.

Obs. 5.—To show the influence of weight laid upon the sternum. A 7 lb. weight on the sternum expelled 1 cubic

inch of air; a like amount re-entered the chest on removing the weight.

Obs. 6.—Weights to the amount of 14 lb. expelled 3 cubic inches. A like amount of air re-entered on removing the weights.

Obs. 7.—Weights to the amount of 20 lb. expelled 4 cubic inches. The amount which re-entered on removing the weights was not noted. In the last three observations the weights were placed upon a board lying in the axis of the body, so as to diffuse the pressure.

Obs. 8.—Twenty pounds in weights lying across the lower part of the sternum, expelled 6 cubic inches of air; 5 cubic inches re-entered the chest on removing the weights.

Obs. 9.—Repetition of Observation 8: results the same.

Obs. 10.—Weights to the amount of 20 lb. laid across the upper part of the sternum expelled 5 cubic inches of air; 4 cubic inches re-entered on removing the weights. No increase in the amount of air expelled took place on moving the weights lower down the sternum.

Obs. 11.—Pressure with the hands on the lower part of the sternum expelled 6 inches; 4 cubic inches re-entered on withdrawing the pressure.

Obs. 12.—On applying the stethoscope to the thorax, while Silvester's method of imitating respiration was being employed, a distinct and continued subcrepitant râle was heard during inspiration, and also, though less in duration and strength, in expiration. The surface of the thorax was not œdematous, as proved by division of the skin. The results were the same when the stethoscope was applied over the denuded muscles of the thorax as over the skin.

March 24th, 1862.—At St. Bartholomew's Hospital.

Subject IV.—A middle-aged, emaciated man, died of phthisis and destitution; dead about three days. Rigor mortis moderate. Apex of right lung rather dull on percussion.

Obs. 1.—To determine amount of air introduced into

lungs without opening the trachea. The nose and mouth were covered with the mouth-piece of an inhaling apparatus and made quite air-tight, except where communicating with the tube of the instrument employed for the purpose of the observation. The body was placed supine: the head hanging back over the edge of the table. On applying the Silvester method of inspiration no air was drawn into the chest.

Obs. 2.—Repetition of the above, with the exception that the head was placed level on the table: the same negative result was observed.

Obs. 3.—Another repetition: the head now turned to one side; result the same.

Obs. 4.—Another repetition: body placed on abdomen, forehead resting on arm: the same negative result.

Obs. 5.—Position the same as in Observation 4; pressure now made on the back expelled 1 cubic inch of air, which re-entered the chest on relaxing the pressure.

These observations showed that there was some obstruction interfering with the entrance of air into the chest. The mouth was rather firmly clenched, and was with difficulty forced a little open, yet the nostrils were probably free; it was thought, therefore, that most likely the obstruction was situated about the glottis, and occasioned by the tongue.

Obs. 6.—The trachea was now opened and a tube introduced and secured, as in all the previous observations. Silvester method. Only about $1\frac{1}{2}$ cubic inches of air could be interchanged Probably some obstruction in the lungs or air-passages.

Obs. 7.—Marshall Hall method. Only about $1\frac{1}{2}$ cubic inches of air could be interchanged by this, as by the last method.

Further experiments with the body were, accordingly, not tried.

March 24th, 1862.—At St. Bartholomew's Hospital.

Subject V.—A middle-aged woman; died of epilepsy.

Obs. 8.[1]—Marshall Hall method. On turning the body to the side from the supine posture, 5 cubic inches of air were inspired; on placing the body prone, with forehead resting on hand, only 2 cubic inches of air were expelled.

(There is a note to this observation that it was not a satisfactory one.)

Obs. 9.—The plan of rotation, according to Dr. Marshall Hall's directions, was now practised several times, with the same general result, namely, that about 5 cubic inches of air were interchanged by the rotating process; and that 5 additional cubic inches were expelled by pressure on the back while the body lay on the abdomen.

Obs. 10.—Dr. Silvester's method. On elevation of arms, 9 cubic inches of air inspired; on depression of arms, 6 cubic inches of air expired.

Obs. 11.—The last observation was repeated several times, and with the average result, that 5 or 6 cubic inches of air were interchanged.

No pressure on the sternum was practised in these observations; they were limited to the effects of simple elevation and depression of the arms.

Obs. 12.—Pressure on the sternum with the hands, expelled 8 cubic inches of air.

Obs. 13.—Marshall Hall method repeated. Only 2 cubic inches could now be interchanged.

Obs. 14.—The same repeated with both arms folded under the chest; this arrangement caused an additional expulsion of 4 or 5 cubic inches.

Obs. 15—Attempts at inflation of the lungs by a pair

[1] Numbered in continuation of last series, the experiments being conducted on the same day.

of bellows succeeded in forcing in only 2 cubic inches of air.

The experiments with this body were discontinued.

May 31st, 1862.—At the Marylebone Workhouse.

Subject VI.—An old man; dead about twenty-four hours; emaciated; died from old age and bronchitis. (The lungs were examined after the experiments, and found largely infiltrated with bloody serum, and the smaller bronchi plugged with ropy mucus.)

Obs. 1.—To determine influence of tongue in impeding entrance of air into the lungs.

A.—When the tongue was drawn forward out of the mouth, and held there by a ligature, air could be readily blown down the trachea and œsophagus, visibly distending the thoraic and abdominal cavities.

A a.—Pressure on the larynx interrupted the passage of air along the œsophagus.

B.—When the tongue was pressed tightly back into the pharynx entrance of air was prevented, both into the larynx and œsophagus.

C.—The tongue left loose in the mouth and allowed to fall back by its own weight, permitted the entrance of air into both canals, though less freely than in *A*.

D.—When the head hung back over the table, air seemed to pass more freely than when it was simply resting on the table.

Obs. 2.—The trachea was now opened and a tube introduced; air was blown into the lungs and allowed to escape again, and the process was repeated several times in imitation of ordinary respiratory movements. The pressure required to introduce about the amount of air usually respired was equal to that of a column of mercury about one-tenth of an inch in height.

Obs. 3.—Dr. Silvester's method. Head of subject hanging

back over the edge of the table. Only from 4 to 6 cubic inches of air were interchanged by this method.

Obs. 4.—The method repeated. The head was resting on the table; results the same.

Obs. 5.—The method repeated. The head in the same position as in the last observation, a block placed under the shoulders; about one cubic inch more was interchanged.

Obs. 6.—The addition of sternal pressure at the end of the last observation expelled scarcely any more air.

Obs. 7.—Silvester's method again repeated; 6 cubic inches of air were now interchanged. The addition of sternal pressure at the end of the observation expelled about 5 cubic inches more. The small amount of air interchanged in these observations led to the supposition of there being some obstruction either in the air passages or lung structure, or both. Abundant mixed crepitations were detected in the lungs during the forced respiratory movements, and gave support to this view; and examination after the experiments were ended confirmed it. Nevertheless the observations were continued a little longer.

Obs. 8.—Marshall Hall method. On turning the body from the supine to the lateral posture, $1\frac{1}{2}$ cubic inches of air were inspired; replaced on the back no air was expelled. When the body was turned on to the stomach, about 4 cubic inches of air were expelled. Pressure on the back expelled 1 cubic inch more.

Obs. 9.—The last observation repeated; amount of air now interchanged was much less.

Obs. 10.—The Silvester method repeated; scarcely any result, only 1 or 2 cubic inches of air interchanged.

Obs. 11.—The bronchial tubes were now cleared of much tenacious, ropy mucus, by repeatedly sponging them out with a probang. The Silvester method was then again repeated, but with the same negative result as in Observation 10. The experiments with this body were accordingly discontinued.

April 17th, 1862.—At St. Bartholomew's Hospital.

Subject VII.—A youth, æt. 17, dead five days from typhus fever. There was hypostatic discoloration of the lower parts of the body; the thighs were thickly scattered with petechial spots, the body was deformed from lateral curvature of the spine.

Obs. 1.—On raising the arms according to Dr. Silvester's method, 18·5, 19·5, and 19·5 cubic inches of air were inspired in three successive movements.

Obs. 2.—On making compression on the sternum, 14·5 cubic inches of air were expelled, but on relaxing pressure only 11 cubic inches entered the trachea.

Obs. 3.—On repeating the last observation, 12 cubic inches of air were expelled by compression of the sternum, and 11 cubic inches re-entered the chest on relaxing the pressure.

Obs. 4.—Repetition of the last observation; 13 cubic inches of air were expelled by compression of the sternum; 12 cubic inches re-entered on relaxing the pressure. The experiment was repeated several times, with exactly the same results.

Obs. 5.—On raising the arms, according to Dr. Silvester's method, 15 cubic inches of air were inspired. On replacing the arms to the sides 10 cubic inches were expired. This observation was repeated several times, with the same result.

Obs. 5 *a.*—Pressure applied to the sternum after the last Silvester observation expelled 17 cubic inches of air. On withdrawing the pressure, however, only 11·5 cubic inches of air were inspired.

Obs. 6.—The arms were again raised, according to the Silvester method, and compression applied immediately after they had been brought to the side, with precisely the same results; and this process was repeated several times.

Obs. 7.—The body was placed in the prone posture, with the right arm under the forehead, and the position of the

needle noted. The body was then turned over so as to rest on the back; the position of the needle was unaltered. On placing the body on the side, 2·5 cubic inches of air entered the chest. On placing the body in the supine posture, the same quantity of air escaped.

Obs. 8.—On placing the body on the left side and a little over, 8 cubic inches of air were inspired. On repeating the prone posture, 5 cubic inches were expelled. In alternating the two postures several times, the following quantities of air were successively inspired and expelled:

Inspired,	1·5	cub. in.;	expelled,	3	cub. in.
„	4	„	„	3	„
„	4	„	„	6	„
„	6	„	„	5	„
„	6	„			

The body was then placed on the back, when it was observed that the index remained unaltered.

Obs. 9.—The method of Dr. Silvester was then repeated; 11·5 cubic inches of air were inspired on raising the arms; 11·5 cubic inches expelled on replacing the arms; 16 additional cubic inches were expelled on compressing the sternum, yielding a total of 27·5 cubic inches of air expelled from the chest.

June 14th, 1862.—At the London Fever Hospital.

Subject VIII.—The body of a well-formed man, æt. 59, (apparently older), about five feet ten inches in height, who had died on the previous day of typhus. Rigor mortis present in a marked degree; typhus eruption visible on trunk and thighs; slight hypostatic discoloration, no signs of putrefaction.

Obs. 1.—On compressing the chest (the body being on the back) with the hands, no air escaped by the mouth so long as the tongue was untouched. On drawing it forward, air began to escape on compression, with a gurgling sound; on drawing the tongue forwards, and holding it forwards

with a strong wire bent into the form of an aneurism needle, the passage of air was perfectly free in both directions. This was frequently repeated.

Obs. 2.—The cavity of the thorax was connected, air-tight, with a water-manometer, by a tube inserted in the trachea. The reading of the manometer being 0·0, a board was laid on the sternum: reading, in inches, 0·15. A weight of 4 lbs. was placed on the board: reading 0·5. This was then replaced by a weight of 14 lbs.: reading 1·7. The board and weight were then removed: reading 0·0.

Obs. 3.—The same weight, 14 lbs., was placed without a board on the sternum, in several positions, with the following results:—

Position of weight.	Reading of manometer.
3 inches below level of nipples, which in this body corresponded to fourth sternal articulations	1·3
$1\frac{1}{2}$ inches below the same line . . .	1·6
1 inch below	1·75
$\frac{1}{2}$ inch below	1·8
At level of nipples	1·75
1 inch above	1·7
2 inches above	1·6
$2\frac{1}{2}$ inches above	1·45

All the above determinations were repeated.

Obs. 4.—Two weights, each of 14 lbs., were placed on a board as before, across the sternum. On arranging the board, so that the weight should rest on the sternum in the most advantageous position, the reading was + 3·6. On allowing the air to escape by opening the tube, and again closing it, and then removing the weight, the reading became — 3·5.

Obs. 5 *a*.—A weight of 14 lbs. was placed on the sternum, the reading was as before + 1·8. *b*. Air was allowed to escape, and the tube was again closed; on removing the weight the reading was — 1·8; on repeating *a*, the reading was + 1·7; on repeating *b* — 1·7; on repeating *a*, a second time + 1·75; on repeating *b* a second time — 1·7.

Obs. 6.—On extending the arms upwards (Silvester) the reading at first was — 8·0, but it fell almost immediately to — 5·0. The first effect was clearly owing to the rigidity of the muscles, which, on the first extension, strongly resisted the movement of the arms.

Obs. 7.—On extension, the reading was — 5·55; on relaxation — 0·4; on extension — 5·0; on relaxation — 0·2; on extension — 4·5; on relaxation — 0·2; on extension — 4·5; on relaxation — 0·2.

Obs. 8.—Dr. Marshall Hall's method. The body being supine, and the reading — 0·2, it was turned on the left side, so as to rest on the inferior angle of the scapula. The reading was permanently — 4·0; on pronation, it was — 0·4; on semi-respiration (body resting on angle of scapula) — 4·0, nearly; on supination — 0·8; on rotation to side (body resting as before) — 5·0; on pronation — 0·4; on supination — 0·4.

Obs. 9.—The experiments with the 28 lbs. weight were repeated with the same results, viz.: weight on sternum + 3·6; weight removed + 0·13; pressure with the hand applied pretty firmly, gave + 4·0; applied strongly, it gave + 4·5 or 5·0. From comparison of the pressure used with that used on former occasions, it may be stated that 30 lbs. represents about the pressure that ought to be employed in Silvester's method.

General Results.

I.—As regards the volume of air which can be expelled from the thorax by compression of its walls, and inspired by the elastic expansion consequent on relaxation of the pressure, it was found:

a. That pressure by both hands on the lower third of the sternum in the adult male subject usually displaced from 8 to 10 inches of air.

The pressure actually exerted amounted to about 30 lbs;[1]

[1] It was therefore not greater than might be safely applied to the living subject.

the volume of air expelled varied from 8 cubic inches (Sub. V, Obs. 12) to 15 cubic inches (Sub. I, Obs. 4).

b. That pressure made in the same manner on the upper part of the sternum usually displaced 2 or 3 cubic inches less than pressure on the lower part (Sub. II, Obs. 12).

c. That pressure exerted by one hand on the upper part, by the other on the lower part of the sternum, produced about the same results as were observed in *a* (Sub. II, Obs. 13).

In this case the whole amount of pressure did not exceed that exerted in *a*.

d. That the pressure of a weight laid on the lower third of the sternum produced similar results, according to its amount.

Thus a weight of $5\frac{1}{2}$ lbs., expelled a fraction of a cubic inch of air (Sub. III, Obs. 4 and 5), a weight of 20 lbs. in the same body expelled 5 cubic inches, (Sub. III *a*, Obs. 10).

The quantity displaced in the same subject by manual pressure was 10 cubic inches (Obs. III *a*).

e. That lateral pressure exerted on the ribs or costal cartilages of both sides simultaneously, was in no instance more effectual, if anything rather less (Sub. I, Obs. 8, and Sub. II, Obs. 14).

f. That compression by a broad bandage encircling the chest, the ends of which were crossed over the sternum and drawn in opposite directions by two persons, produced no greater effect than pressure with the hands on the sternum or sides, *i. e.*, 8 to 10 cubic inches (Sub. II, Obs. 18).

The investigation of this mode of pressure was relinquished after a few trials, because of its apparent inutility and inapplicability to the living subject.

II. The method recommended by the late Dr. Marshall Hall for imitating respiration was applied to each of the subjects experimented upon, in accordance with his published instructions. Sometimes this plan was tried first, before any other method was employed, sometimes afterwards. It was usually repeated several times on the same subject, and during the same series of experiments.

As regards that part of the method which consists in turning the body alternately "very gently on the side and a little beyond, and then briskly on the face," it was found that the volume of air exchanged was variable in the same subject, but always inconsiderable. It usually happened that a quantity of air, varying from 1 to 8 cubic inches, never more, generally much less than 8, was inspired when the body was turned from the supine posture to one side. When the body was placed on the abdomen with the head resting on the forearm, a somewhat larger quantity was expelled, never exceeding 10 cubic inches. On restoring the body to the lateral posture, the amount of air inspired was usually less than that which had been expelled by pronation. But the quantity expelled and inspired in each movement was scarcely ever precisely equal.

The volume of air expelled when the body was placed on the face was much increased if pressure was at the same time made on the spine, the amount of this increase varying according to the degree of the pressure, and in those experiments in which such pressure was made, it was found that the quantity of air which was inspired on rotation of the body to the side, was much less than that which had been expelled by pressure.

As regards the whole amount of exchange of air produced by the method of Dr. Marshall Hall, "to imitate respiration" it varied much according as the subject was favorable, or the contrary, sometimes not exceeding a few cubic inches, but never exceeding 15 cubic inches.

III. As regards the method above described as that of Dr. Silvester, it was found that, on extending the arms upwards, a volume of air was inspired into the chest which varied, in different subjects, from 9 to 44 cubic inches; and it was observed that the results obtained in successive experiments on the same body were remarkably uniform, in which respect, as well as in their quantity or amount, they contrasted with those obtained by the method of Dr. Marshall Hall. On restoring the arms to the side, as directed by

Dr. Silvester, the quantity of air expelled was generally nearly equal to that previously inspired, occasionally less.

Dr. Silvester recommends that on bringing down the patient's arms they should be gently and firmly pressed against the sides of the chest, so as to diminish the cavity of the thorax. It was found that this pressure could be exercised with greater facility, and equal effect, by placing the hands on the lower third of the sternum, as already above described. By alternating the movements of the arms with pressure of this kind, a regular exchange of air was produced, the quantity of which, in several instances, exceeded 30 cubic inches, and in one instance amounted to 50 cubic inches. In those cases in which a less respiratory effect was produced, the deficiency was always distinctly attributable to unfavorable conditions, particularly the existence of obstructions in the respiratory passages.

Without expressing an opinion as to the efficacy of the method of Dr. Silvester as a means of restoring suspended animation in cases of drowning, its claims to be considered as an effectual means of producing an exchange of air similar to that effected by the respiratory movements, appear to us to be satisfactorily established. As has already been pointed out by Dr. Silvester, the condition of the thorax after the cessation of breathing being that of expiration, it is desirable that the first step in the restoration of breathing should be a movement of expansion; in this respect the method he has proposed enjoys a marked superiority over that of Dr. Marshall Hall, which has for its object to force air from a chest which has already discharged its natural quantity. It also appears to be an important advantage in this method, that, in each movement of expansion, both sides of the chest are left free from compression, and therefore free to move, while the postural method of Dr. Marshall Hall leaves only one side free to expand. As regards facility, and readiness of application, there is also no doubt that the method recommended by Dr. Silvester is at least equally if not more effective than the Marshall Hall plan.

In the course of the experiments on the dead body certain facts and observations were recorded not immediately bearing on the main subjects of inquiry. The principal of these are stated in the following paragraphs:

Inflation.—A few experiments were performed relating to the efficiency of the inflation of the lungs through the mouth of the subject, which led to the conclusion that with proper precautions, such inflation is perfectly practicable. The following were among the results noticed:

1. As regards the position of the tongue and its influence in impeding the entrance of air, it was found that in the dead body this organ is apt to offer great obstruction to inspiration by falling back into the pharynx, and closing the laryngeal aperture. No air could be forced through the mouth in a body lying on the back so long as the tongue remained undisturbed, but when it was drawn forward and held out of the mouth by a ligature, or by the pressure of the teeth upon it, air could be injected by the œsophagus and larynx, so as to distend both the abdominal and thoracic cavities. On leaving the tongue loose in the mouth, and allowing it to fall back by its own weight, air could also be introduced, but much less freely than when it was drawn forwards. Complete obstruction to the passage of air was produced by pressing the tongue back into the pharynx, no air entering either the larynx or œsophagus.

When the head of the subject was allowed to hang back over the edge of the table, air seemed to pass into the chest more readily than when the back of the head rested upon the table.

2. It was found that the whole quantity of air introduced by inflation could be compelled to enter the respiratory cavity by pressing back the larynx against the spinal column. By this expedient the passage of air down the œsophagus was at once intercepted, while its transit down the trachea continued to take place as freely as before, so that it affords a ready means of preventing the passage of air into the stomach during artificial respiration.

3. During inflation of the lungs a sound, closely re-

sembling that of the ordinary vesicular murmur, is plainly heard, proving that air enters not merely the larger air passages but the vesicular structure of the lungs. Marked expiratory murmur was also heard during the recoil of the lungs and thoracic parietes after inflation. In cases where the bronchial tubes were obstructed by secretion, the various kinds of crepitation could be distinguished.

Rigor mortis.—The effects of rigor mortis were judged of by observations on one subject especially. It was observed that, after prolonged experiments, the rigidity, which at first existed in a marked degree, was completely overcome and abolished by the repeated movements of the arms and thoracic parietes. As this change took place, the quantity of air inspired and expelled increased, so that at the end of the period of observation the results were nearly twice as large as they were at the beginning.

In the treatment of apnœa generally, the Committee venture to offer the following suggestions:

That all obstruction to the passage of air to and from the lungs be at once, so far as practicable, removed; that the mouth and nostrils, for example, be cleansed from all foreign matter or adhering mucus.

That, in the absence of natural respiration, artificial respiration, by Dr. Silvester's plan, be forthwith employed in the following manner:—The body being laid on its back (either on a flat surface, or better, on a plane inclined a little from the feet upwards), a firm cushion, or some similar support, should be placed under the shoulders, the head being kept on a line with the trunk. The tongue should be drawn forward so as to project a little from the side of the mouth; then the arms should be drawn upwards until they nearly meet above the head, the operator grasping them just above the elbows, and then at once lowered, and replaced at the side. This should be immediately followed by moderate pressure, with both hands, upon the lower part of the sternum. This process is to be repeated about twelve or fourteen times in the minute.

That if no natural respiratory efforts supervene, a dash of hot water (120° Fahrenheit) or cold water be employed, for the purpose of exciting respiratory efforts.

That the temperature of the body be maintained by friction, warm blankets, the warm bath, &c.

In the case of drowning, in addition to the foregoing suggestions, the following plan may be, in the first instance, practised:—Place the body with the face downwards, and hanging a little over the edge of a table, shutter, or board, raised to an angle of about 30°, so that the head may be lower than the feet. Open the mouth and draw the tongue forward; keep the body in this position for a few seconds, or a little longer if fluid continues to escape. The escape of fluid may be assisted by pressing once or twice upon the back.

It will be seen that these investigations relate only to two forms of apnœa—that produced by the simplest means, apnœa in its least complicated form, and that produced by drowning. It was found to be utterly impracticable, in the time allotted, to extend our inquiries to other forms of apnœa. Indeed, even within these limits, the Committee have found it necessary to disregard many collateral questions of great interest, and to confine their attention to the chief features of the subject.

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DESCRIPTION OF PLATE VI, VOL. XLIV.

The group at the upper half of the plate represents epithelial and other casts, with loose cells of renal epithelium, observed in the urine of patients proved by post-mortem examination to have suffered from chronic nephritis.

On the lower part of the page are seen the granular and hyaline casts, with various forms of epithelial cells, afforded by patients ascertained to have been affected with granular degeneration of the kidney.

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